MACHINERY.

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THE UNION IRON WORKS.

THE FAMOUS SHIP YARDS OF THE PACIFIC COAST, WHERE THE OREGON AND OTHER NOTEWORTHY VESSELS HAVE BEEN BUILT.

J. RICHARDS.

Among the phenomenal growths of organized industrial establishments in this country, none are more notable than the Union Iron Works at San Francisco, not only or so much in extent as in character. This growth of thirteen years has not been, as is usual, an expansion by expedients, but an orderly development on the lines of modern and advanced practice. There are no make-shifts, no use of antiquated implements. The progress from the beginning has been constant in implements, processes and results that compare favorably with and in some respects exceed what can be seen in the best European shipbuilding yards. The implements are more special in nature and adaptation and in a good many cases are of greater power and capacity than can be found elsewhere on this Continent. Of these more will be said in a future place. The main point of the Union Iron Works is situated about one mile southwest from the center of the city, at the Portrero, which is an old Spanish name for a pasture field or plain. The works cover 22 acres of ground—not only occupy, but cover, because there are nine acres of permanent buildings, not including what seems to be ship houses, but what are in fact huge gantrys that cover and surround each vessel during construction. These structures are mainly for handling purposes—that is to support traveling cranes operated by power that reach all points over, on and in the vessels. There is no carrying structural material up stages or lifting it to place by hand, and consequently none of the accidents so common when material is handled from scaffolding alone.

There are employed at this time 3,000 men that produce $3,000,000 of work in a year, $1,000,000 of which is general engineering work such as hydraulic and mining machinery, the latter being for the most part constructed in the City Works, where there is an auxiliary plant to accommodate from 150 to 200 men.

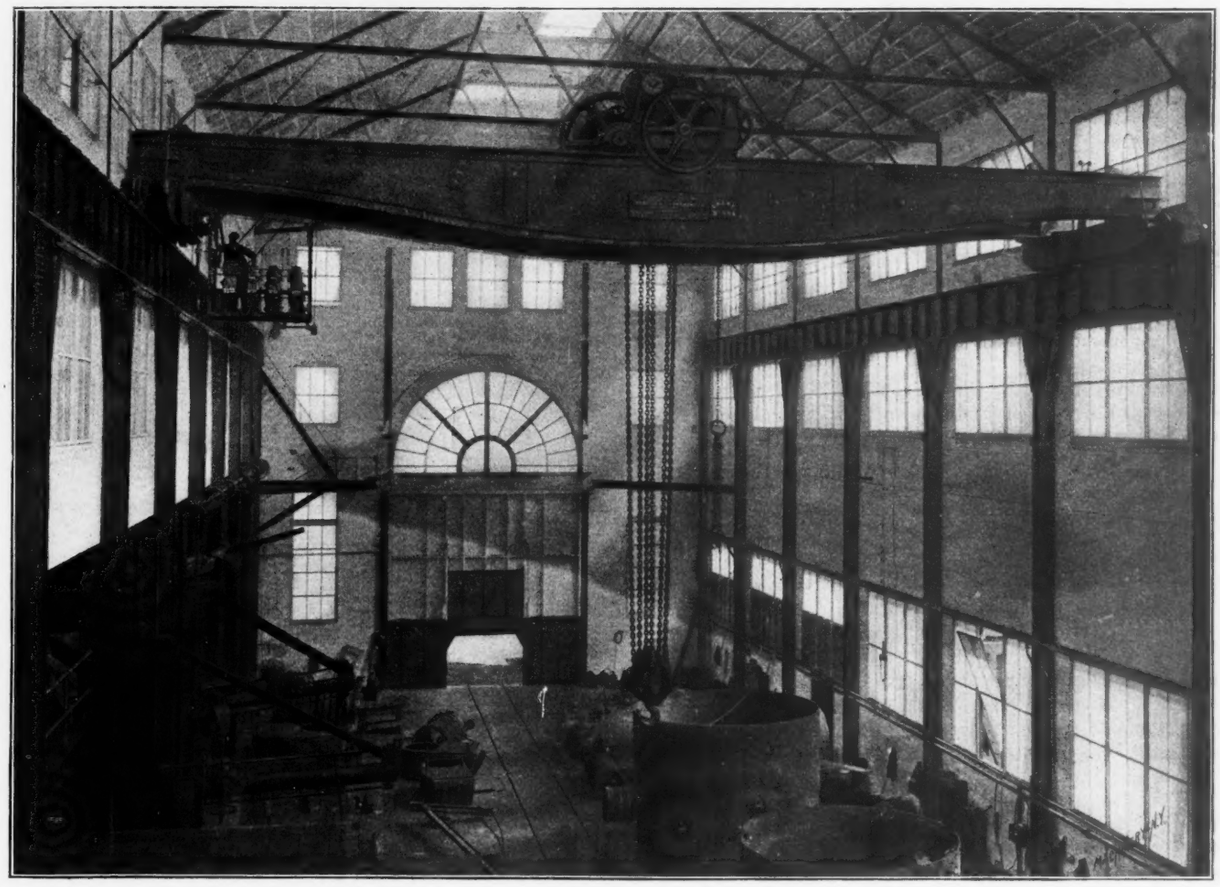


Fig. 1, showing the fifty-ton electric traveling cranes in the boiler shop. There are two of these cranes moving on the same ways, similar to the one shown in the illustration. The illlustration also shows two jib drills for drilling the large boiler shells. The span of the large crane is 60 feet, the hoist 40 feet.

Of merchant shipping the facilities are equal to producing 30,000 tons a year. Last year 22,000 tons of mixed war and merchant vessels were launched, but comparisons in this direction will wholly fail to indicate the real producing power of the works, because the system and policy pursued as well as the circumstances are different from corresponding works in the East, where shipbuilding means to a great extent assembling instead of making. For example, a large war vessel contains in all from fifty to one hundred steam engines. Of these there are made in the Eastern works little more than the main propelling engines, all the auxiliaries for pumping, handling, lighting and so on being purchased from other firms or companies who make a specialty

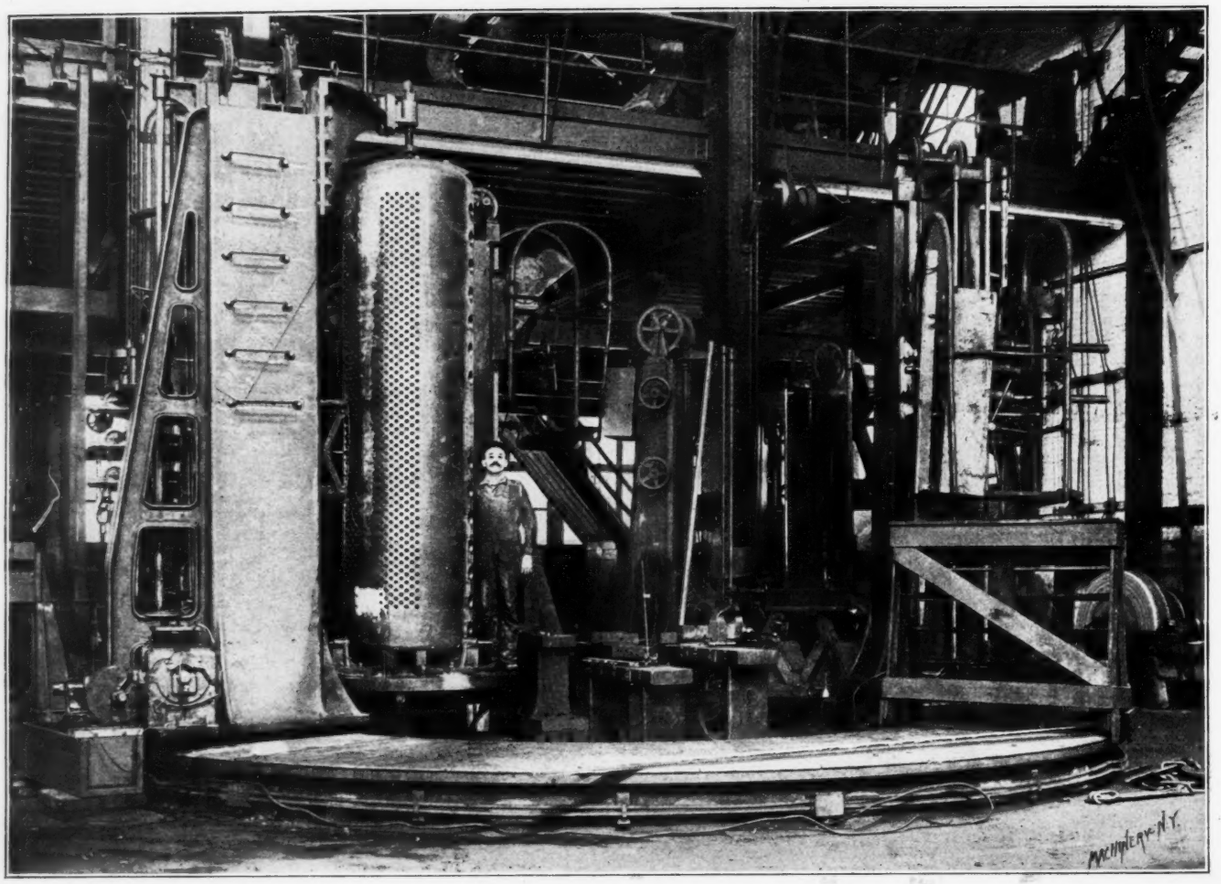


Fig. 2, showing the new boiler shell drilling machines in the boiler shop. These drilling stands traverse on a 30-foot circle and will receive a boiler shell of 18 feet diameter. There are five of these stands, some of them having three drills that can all operate at a time on a large shell, or they can operate separately on smaller shells. The upper drum of a Thornycroft boiler being drilled is shown on the left-hand side.

of these things; but at the Union Iron Works these are all made, as are the fittings of all kinds, down to water and steam cocks even, and all of the fittings in the electrical equipments.

Any skilled person in passing through the workshop can see that at least a fourth of all the men are engaged in making such things as are purchased in the Eastern shipbuilding yards. This calls for an extensive and varied equipment of tools, indicated by the fact that in one year (1897) there was added to the tool account $450,000, the largest amount perhaps ever purchased in the same length of time by any "going works" in this country.

An elaborate equipment of tools of a varied character is required in this manufacture and is provided by necessity and also by choice. There are no resources outside of the works nearer than two to three thousand miles away where supplies can be purchased.

Some time ago, when passing through a new building at the works in company with the manager and chief engineer, Mr. G. W. Dickie, we came upon a room filled with shelving all around piled with brass flanges, bored, faced and drilled ready for use. Mr. Dickie remarked, "We have just made up a stock of 25 tons or so. These are invoiced at 40 cents a pound in this finished state or worth $20,000."

Think of this amount of small brass flanges! But all other things are in proportion. A pile of boxes impeded our way—a car-load of candles that had just come in! On the day mentioned the stored stock in the works stood at $1,000,000. In the Eastern States these things, most of them, can be ordered when wanted and no such expensive stores are required. The merchandise stock account in iron, steel, rivets, tubes, plates, timber and so on, sometimes exceeds a million of dollars; that is an average.

The dry dock is of the hydraulic type and of unique construction, being raised by 36 hydraulic rams, 30 inches in diameter, all moving in unison. The dock is 450 feet long, 62 feet wide, raises 4,000 tons, and was erected at a cost of $400,000.

Among the handling tackle in the works are twenty-one traveling cranes; five of them raise 50 tons each and six of them 20 tons; sixteen are operated electrically.

This will do for figures and quantities, unless it be to add that it requires $3,000,000 of capital to carry on the business. In 1886 the ground on which the works stand was a swamp, or at least low foreshore with a substream of silt or depth like unto Chat Moss, in Lancashire, that Robert Stephenson filled in.

Most interesting of all is to conjecture where the skill came from that has organized this great industry and keeps it going abreast with the best practice in the Old World. The problem is not a difficult one, however. The whole industrial world has contributed, with the usual Scotchmen in the lead. The make-up is cosmopolitan. In the draughting room all the industrial nations are represented. It reminds one of Great Britain, where it is said they do not ask where one was born or the color of his skin, but what does he know and what can he do?

To compare with the Clyde Yards, where metal ship building has its head and center, there is some difference in methods and means, and while there is always some new point to be seen there is not to be found in any European yard a general average of efficiency that will excel the Union Iron Works.

This is natural and to be expected. An establishment reared on the "Eclectic" system should be the best and this one is, in all general features. If there is better it is in Ireland, at Belfast, but this works (Harlan and Wolff's) I have not seen for many years, so cannot compare at this time.

The increased rate, or the reduced cost, of cutting, fitting and finishing metal work has immensely increased during twenty years past and the major part of the increase falls in the last decade. This progress is commonly ascribed to new processes or methods, but this is only one factor out of many. Heavier and stronger tools, better made, is a principal cause. Better and more uniform material another. Duplication a third and indeed greatest of all. We are not wiser than our progenitors, but have better opportunities. Any one of half a dozen machine tool-makers at the beginning of this century, that could be named, did more in original design than as many hundreds

of our time; that is, did more, in a general way, if their work is measured by the comparative effect produced. Then the field was narrow and opportunity was wide; now the field is wide and opportunity is narrow. The work of the individual is now lost in a sea of industrial turmoil and must be estimated on a different basis altogether.

A little improvement that augments the out-put of a thousand lathes ten per cent. is now more important than one that doubles the capacity of a hundred lathes, or rather is the same thing in an economical sense.

The principal feature of the Union Iron Works is, as has been intimated, in their implement equipment and mainly in tools made in the works, because not procurable elsewhere or too heavy to be profitably transported. To illustrate this there have been selected some of the large special implements shown in the photo-plates herewith and briefly described in the explanatory notes. Except in two cases the implements shown were made in the works. Some of the largest implements in the machine shop are omitted because they could not be photographed. Among these are a radial drilling machine, made by the Shanks, at Glasgow, that weighs more than 100 tons, and horizontal boring machines of great capacity.

These notes respecting the Union Iron Works were suggested by the fact that in a recent article on American ship-building yards that recently appeared in a popular magazine* the writer did not think it worth while to mention these works, which reminds us of the fact that about twenty years ago an inquiry was sent out to the Pacific coast by the government officers inquiring whether castings of large size could be made there, and in answer found out that the Risdon Iron Works at San Francisco had the heaviest equipment in this country for moulding, pouring and handling castings. This works had then in their foundry fifteen hydraulic cranes and melting capacity beyond any firm in the East at that time.

The writer, who came to the Pacific coast about that time, found in the works above-named an organized machine for pumping water 2,000 feet high that cost $250,000, and occupied a space 60 x 30 x 17 feet and constructed under a guarantee of performance that made it the boldest venture in machine construction he had ever seen in this or other country.

Of these remarks concerning the Union Iron Works, it may be said there is but the one shipyard at San Francisco; but there are more and I will venture the claim that the Fulton Engineering and Shipbuilding Works, the next in rank, have constructed more sea-going steam vessels in the last decade than any similar works on the Atlantic coast—not less than 125, or about 16 each year. These were mainly small vessels in the coast trade. The bay and ferry steamers are all built here and of these no mention is required. The ferry boats have no parallel that I am aware of.

* * *

We have often pointed out that good machine design depends more upon good judgment and practical experience than upon an exact knowledge of mathematics and the actual stresses and strains that occur in the operation of machinery. It is more a question of making parts so they will not deflect appreciably or wear out rapidly than of their actual breaking strength. There are cases, however, even in the simplest work, where such theoretical knowledge discounts practical judgment ten times over. A case in point is that of the gangplank of one of the Mount Desert (Me.) ferryboats, which broke while a large crowd was passing over it on Sunday, August 6, and precipitated a score of people to their death. This particular plank may and may not have been carefully proportioned for the maximum load that it might have to sustain, but if it was built according to the methods usually adopted for details of this or a similar character it was thought sufficient to leave the construction to some carpenter, who, while he may have been a good carpenter, probably lacked just the knowledge required to design a gangplank capable of safely bearing a crowd of people. While in many instances it is not necessary to make calculations for strength, it is unsafe not to do so where life or property is at stake, however unimportant the detail may seem to be.

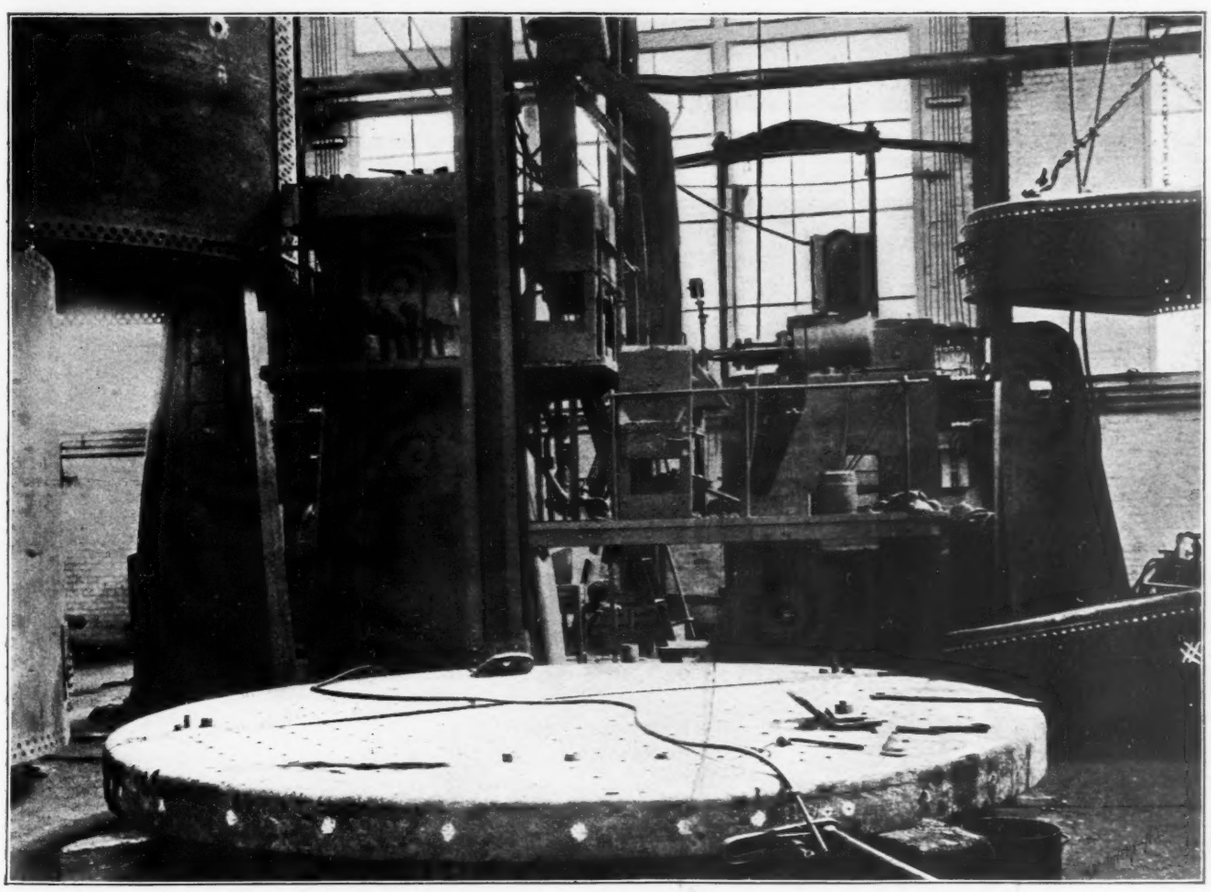


Fig. 3, showing large hydraulic riveting machines in the boiler shop. The one on the left has a gap of 12 feet, and the one on the right hand side, the first one made by the company, has a gap of 8 feet in depth. Both are capable of driving 1¼-inch rivets.

*Metropolitan Magaz ne, June, 1899. "A New Era in American Shipbuilding."

Fig. 4, showing the vertical bending rollers in the boiler shop. These are operated, as all the working tools in the boiler shop are, by electric motors. The motor in this case is shown on tne left-hand side. These rollers take in 1¼-inch plates 12 feet wide.

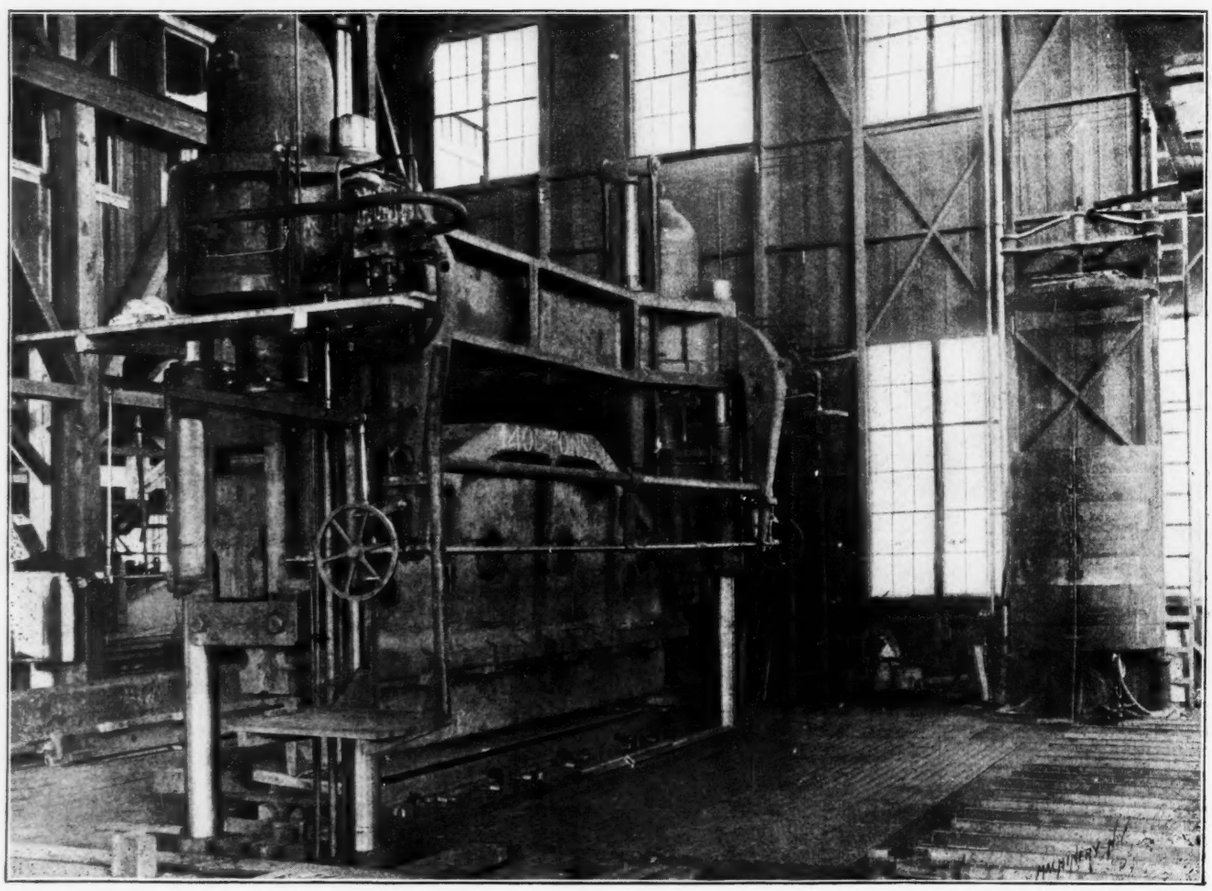


Fig. 5, showing a hydraulic flanging press for flanging and shaping cold steel plates in the shipyard. This press exerts a pressure of 600 tons and can readily bend 4-inch steel plate cold. This is one of the most important tools in the works, and is kept steadily at work.

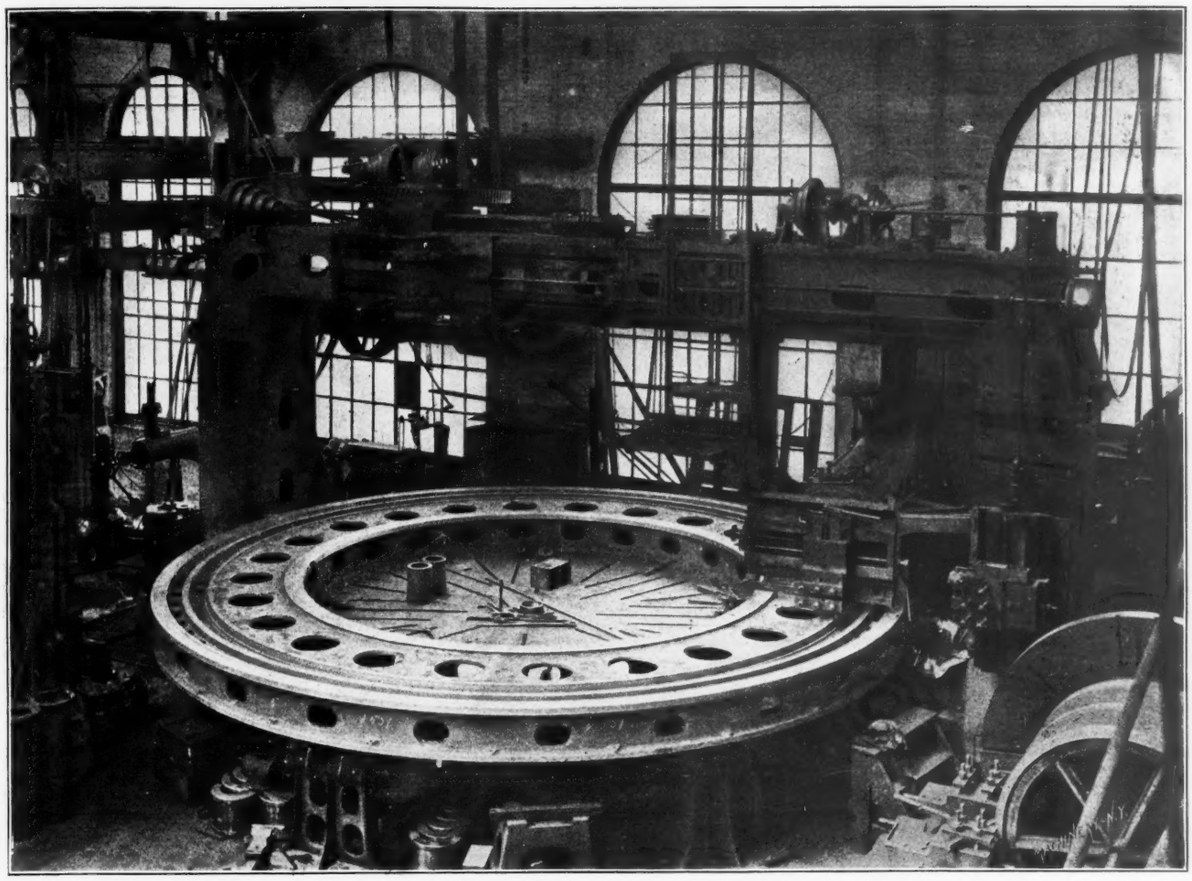


Fig. 6, showing the large horizontal turning mill in the machine shop. This machine turns to 30 feet in diameter. The base ring for the large drilling machine in the boiler shop is shown being machined in this tool. The diameter of the ring is 30 feet.

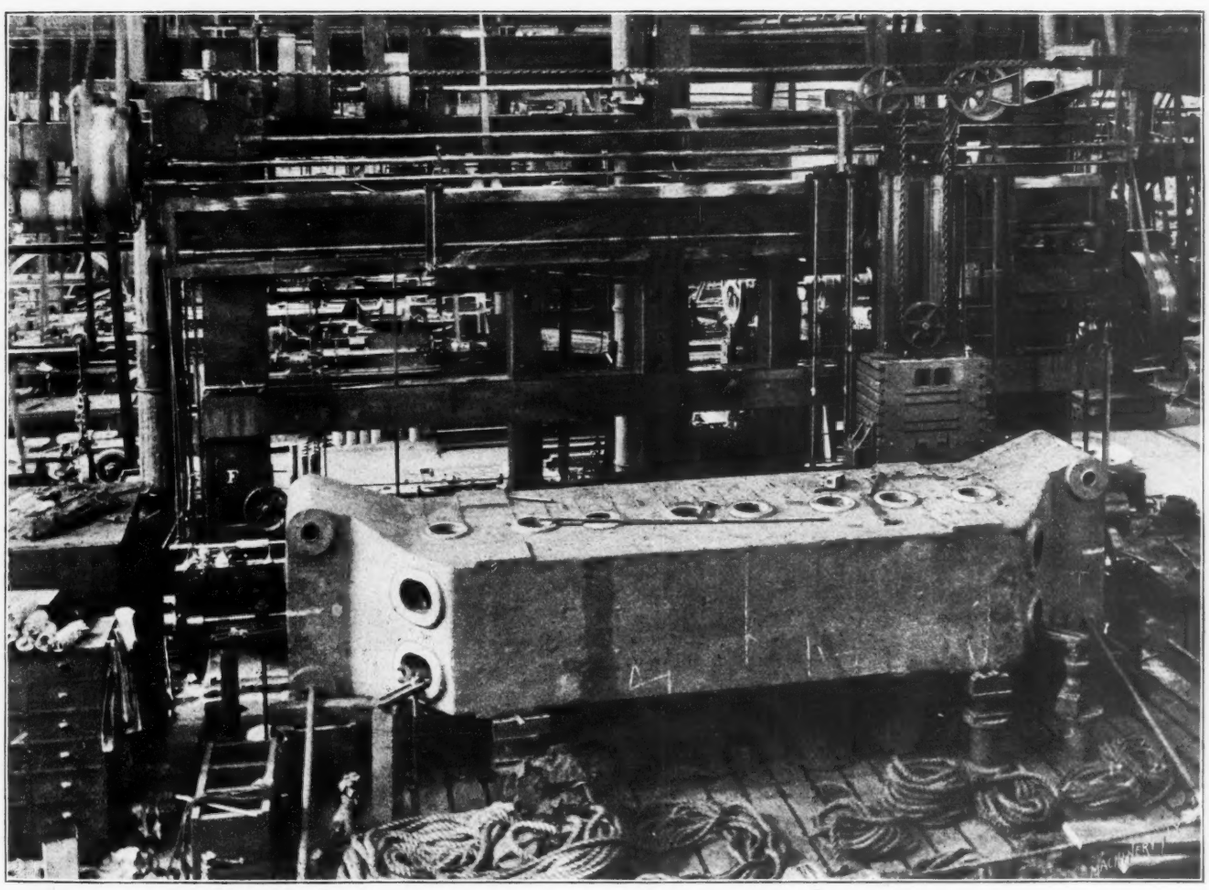


Fig. 7, showing a traversing planing machine with a horizontal traverse of 16 feet. It is shown operating on the bed plate of a large hydraulic flanging press; the casting being operated on weighs 62 tons and is 26 feet long, 6 feet wide and 8 feet deep.

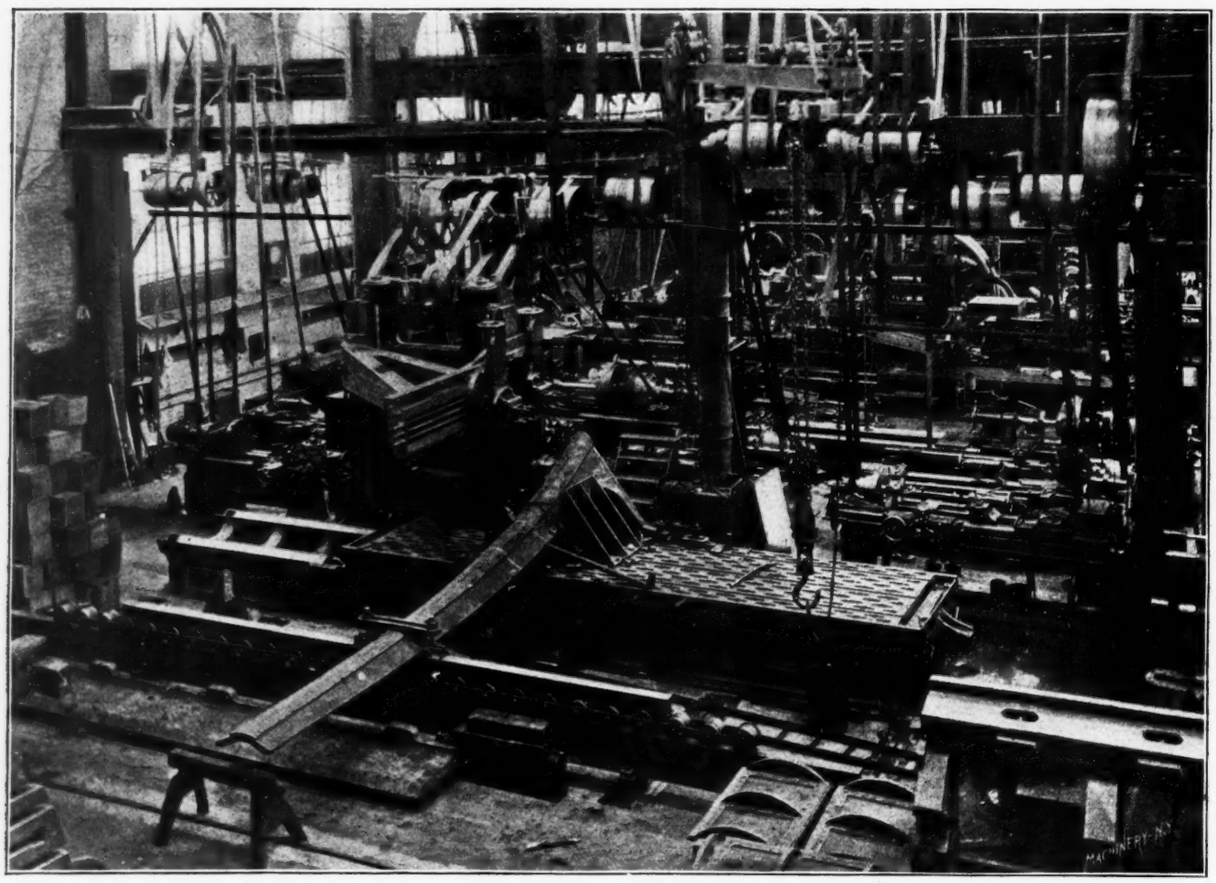


Fig. 8, showing the open side planer, of which there are twelve in use. This is shown operating on the upper portion of the ram of the new battleship Ohio.

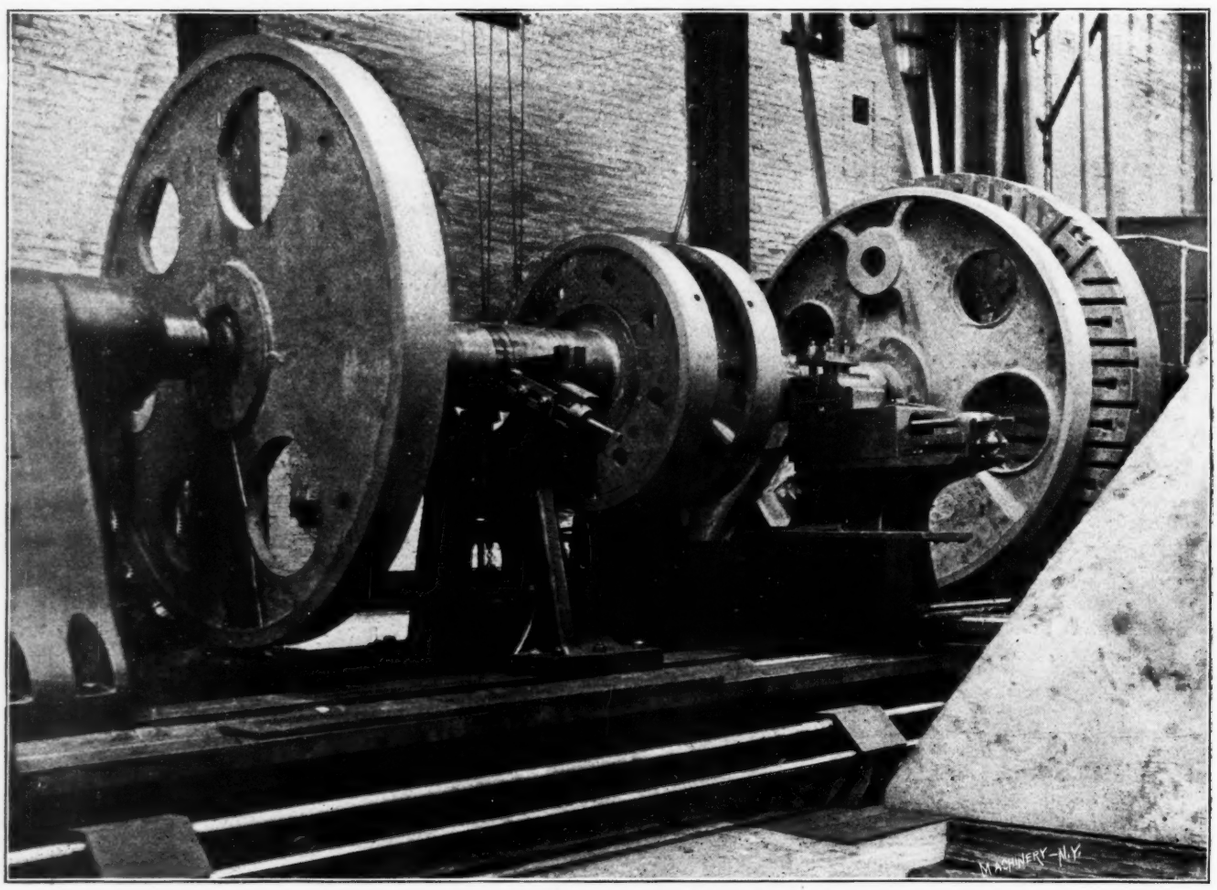
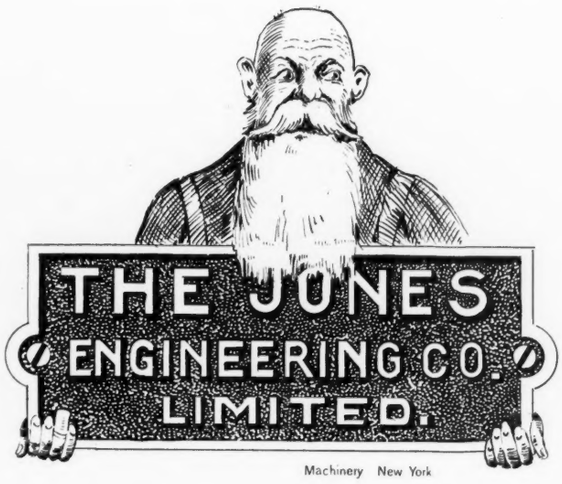


Fig. 9, showing a new lathe recently added in the machine shop. The shaft with the two crank discs, as shown in the lathe, is 34 feet in length, 24 inches in diameter and the crank discs are 10 feet 6 inches in diameter.



It was in a small shop in a small country town that this company was located. In a rural district the people will patronize the small shop before they will the large one. Farmers dislike shop system; they abhor a shop with an office; they care nothing for a clerk with white cuffs; they wish to find the man with the overalls. So Jones started his shop to cater to the wants of the farmers and lumbermen and said to himself; "Now for a name for my shop. I know something about engines and I propose to build a few when the repair work is not crowding, so I will call my concern an 'Engineering Co.'. As I cannot hope to do everything that larger and more complete shops can do, since my facilities are limited, I will call myself 'The Jones Engineering Co., Limited,' and I consider it no disgrace, either, since I read of big concerns like the Carnegie Iron Works who are not ashamed to admit that they are 'limited' and state it so in their firm name!"

So Jones started in business with a firm name and a magnificent ignorance of its meaning, and a half a dozen men. Like the walls of Sparta every man was a brick. Each workman represented half a dozen trades—patternmaking, blacksmithing, plumbing,—in short, all the necessary manufacturing trades except draughting, and thereby hangs this tale. "Aint running no picter gallery," said Jones. "Now you go to a big concern and get a job of that kind done and they will send it into their draughting office and a lot of high priced fellars get together and chew over how the shade lines ought to run and all that sort of thing, and the customer has all that to pay for. Now I'll show you how we

FIG. 1.

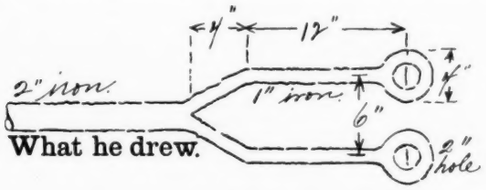


FIG. 2.

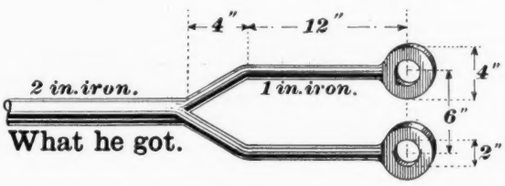
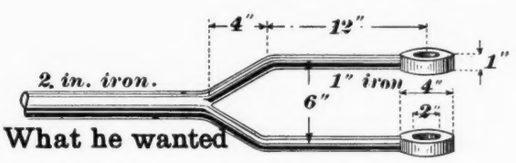


FIG. 3.



Machinery New York

do it. Here's a duffer as wants a truss-rod made and I've got all the dimensions right here in my head; wouldn't give shucks for a mechanic who couldn't carry figures or do sums in his head." While he was talking he was laborously marking out the dimensions for a truss-rod on a board and sprinkled it with figures after much wetting of the pencil in his mouth. "Now my best blacksmith is doing some pattern work that I am in a hurry for so Joe'll have to do it when he gets back from that tin-roofing job, but he has got a good working drawing and he can't go wrong if he tries." Nevertheless when the job was done it was not at all in accordance with Jones' idea of what was wanted. The eyes instead of standing parallel to each other both lay in the same plane, as shown in Fig. 2, which was in fact just what Jones' sketch showed and in this fact lay the blacksmith's refuge. After some wordy argument Jones was obliged to admit that the sketch *might be* misconstrued, but if he had been doing the forging he could have got what was wanted even with that drawing. "But never mind, the fork is long enough so we can give the eye a quarter twist and still get out of it cheaper than to make any high-art drawing." The twist was made as in Fig. 3, and the job delivered to the customer who was a bridge engineer erecting a bridge near by. Jones had a dislike for "scientific fellars" and their educated ways, and he was not at all pleased to see this man carefully caliper the rod in several places, and he was nearly furious to have him declare that the stock in the two forks was too light for the body of the rod. "Takes just one half of the load," Jones explained, "so we made it just half the size, the main rod is 2 in. iron and the two forks are 1 in. each, just the same, d'ye see?" The customer smiled a bit at this explanation. Erecting work in the field had made him resourceful, so taking

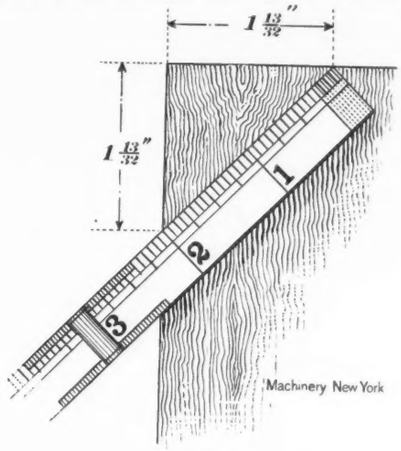


FIG. 4.

a rule from his pocket he measured 2 inches diagonally across the corner of the table as shown in Fig. 4. "Now," said he, "let this line represent the diameter of the large rod, then the distances each way from the square corner of the table to this line would each represent the two smaller rods which in this case would be 1 13-32 in. each." "Well, I swan," said Jones, "that's something like. Say! I'd like to get hold of a book with such recipes as that in it. I s'pose you get those things out of books, don't you?" "That little trick," said the stranger, "is older than the English language, yet I doubt if it was ever printed in any book in just that form, and I doubt if it would help you any if you had the book where it came from; it is the *knowledge* which is needed, then one can make the application at any time or in any form." "Say, stranger," said Jones, "if you should lose your job at any time jest let me know and I'll see what I can do for you; I'd kinder like to have a man round that's handy with his book larning."

W. H. S.

* * *

A recent number of the "Electrical Review" (English) illustrates Humpage's gearing, which, it will be remembered, was described in our February number, and incidentally (and unintentionally) pays a tribute to American methods. This gearing is a form of epicyclic bevel gearing used for back-gears, and the teeth are planed on a Gleason gear-planer. The review says: "This gearing is clearly a machine which will repay the cost of very accurate construction, and the makers are fully alive to this. Machines have only recently been available for cutting accurate bevel gears, and the very best makers of gears, even in America, have been content with the rough approximation to the geometrical form obtained by cutting the teeth with parallel cutters, and doing something or other afterwards to make them look a little better."

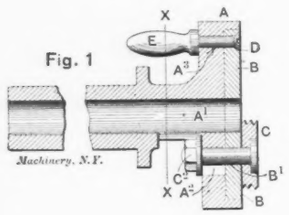
ITEMS OF MECHANICAL INTEREST.

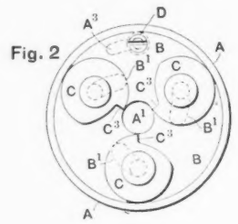
NOTES GLEANED FROM OUR CONTEMPORARIES.

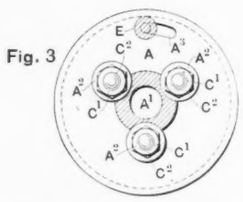
SMILLIES'S THREAD TOOL.

An English patent was recently granted to Mr. John D. Millie, of Lanarkshire, for an improvement in thread cutting tools.

This invention relates to tools for cutting screw threads on bolts, spindles, and the like, and it has for its object to provide in substitution for the ordinary screw cutting dies, a tool the cutters of which have a cutting edge which may be readily renewed or sharpened when worn. It is clearly illustrated by the accompanying drawings, Fig. 1 being a longitudinal vertical section of the tool; Fig. 2 a front elevation, and Fig. 3 a transverse vertical section on the line x—x in the direction of the arrows. The tool comprises a holder A, having a central orifice A1 through which the bolt or spindle operated on passes. The holder carries a circular disc B on which the cutters C are centered. These cutters are held by studs C1 centered through slots B1 eccentric to the center of the disc B, and pass through radial slots A2







in the holder A, the slots A2 and B1 permitting the cutters to be advanced upon or retracted from the job. The studs C1 have nuts C2 on their inner ends so that the head of the studs can be drawn hard against the faces of the cutters C in order to clamp in position with their cutting edges against the work. A bolt D is provided which passes through a hole in the disc B and through a slot A3 in the holder A, and serves to clamp the disc B to the holder A when the desired adjustment or advancement of the cutters has been effected, which clamping is done by means of an internal threaded handle E. The cutters consist each of a circular disc cut away at C3 to provide a cutting edge at one point of the circumference of the disc. The cutting threads are formed around the circumference of the cutting disc C, which arrangement permits of the renewing of the cutting edge of the disc by grinding away a portion of the part C3 radially, thus bringing the new cutting points on to a fresh portion of the cutting threads.

A ROLLER THRUST BEARING.

In a paper read before the Institution of Naval Architects, England, Mr. F. von Kodolitsch describes the results of some shop experiments for determining the difference in efficiency between an ordinary thrust bearing and the roller thrust bearing shown in the accompanying cut. The two experiments could in this case be made in the same bearing, it being so constructed, as reference to the cut will show, that the thrust is taken by rollers when running in one direction, but when going the opposite way is taken on white metal rings.

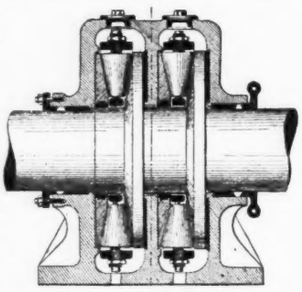


FIG. 4.

The object of constructing the bearing in this manner was that in case the rollers gave trouble on the maiden voyage the section of the shaft carrying the thrust-collars and the block could be turned around, thus converting it into an ordinary bearing.

The results of the tests showed that with a marine engine of 600 H.P., running at 136 rotations per minute, the loss in the plain bearing was 29.75 H.P., whereas the roller bearing only showed a loss of 2.4 H.P. when working under the same load.

Notwithstanding the apparent gain in efficiency, the arrangement scarcely appears feasible for the arduous service required of these bearings in actual service, for while it is highly desirable to reduce the losses from friction to the minimum, the safety and durability of such an apparatus must necessarily be considered first.

A REVOLVING TOOL RACK.

The *Railway Review* recently described a convenient rack for blacksmith tools which is in use in a western railway shop.

In the majority of blacksmith shops, it is the usual practice to have the heavier class of tools, such as larger sizes of tongs, dies or formers of various kinds, sets, flats, etc., and especially tools that are used under the steam and "Bradley" hammers, stacked up in some out-of-the-way corner. When one of these tools is wanted the helper is sent to rummage through the pile to find it. The task of hunting for these tools is not so very troublesome when waiting for a piece to take a heat, and there is nothing else for the helper to do, but if there happens to be a heat on the anvil waiting for the tool to be found, which has occurred more than once, there is considerable annoyance and loss of time on the part of all connected with the job. The piling of these tools in corners and out-of-the-way places does not improve the order and convenience of the blacksmith shop. Fig 5

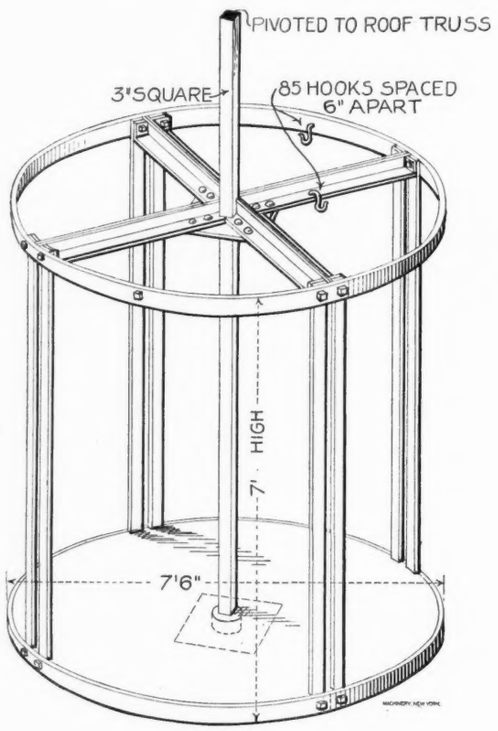


FIG. 5

is a blacksmith shop revolving tool rack made to contain principally the class of tools mentioned above. It can be easily understood how quickly tools can be found when hung on the hooks of the rack.

A man looking for a tool hung on this rack with many others can very likely find what he wants while approaching the rack—go directly to the tool and get it, whereas, when they are piled on the floor in a heap he is able to see only those tools that form the top layer of the pile. There are eighty-five hooks spaced six inches apart to hang tools upon. Such tools as cannot, conveniently, be hung on the hooks are placed on the lower portion or floor of the rack. As this rack is pivoted on a ball bearing thrust and can be easily revolved it is not necessary to place it where it will be accessible from all sides, but can be put in some convenient spot that is accessible from one side only.

FAMILIAR SUBJECTS IN MECHANICS.—4.

BELTING AND PULLEYS (Continued.)

SAMUEL WEBBER.

I find, in looking over my old records, much more material on the subject of belts and pulleys, and will therefore select more that may prove of interest to the readers of MACHINERY.

The tests of 12-inch belts, noted in my last letter, were continued with trials of a rubber belt, under different loads, and as there was no "slip" apparent, on iron pulleys, until the last trial, when the belt "jumped" instantly from the pulley it was not tried on either wood or paper.

This 3-ply belt, 31 feet long, 12 inches wide, weighed 37 pounds, but we had to cut out 11½ inches to get a strain of 43½ pounds per inch upon it. Under this strain it gave the following results:

TABLE I

Load on Brake, lbs.	R. P. M.	H. P.	Slip.	Ft. Belt per min.	Coeff. Friction.	Ft. Belt per H. P. per in.	Strain per inch in lbs.
60	117.6	7.05	0	730	.303	1258	43½
70	115.4	8.07	0	725	.354	1078	43½
75	Slipped	off.					
				Cut out	6 inches;	strained	to 62½
80	115.4	9.23	0	725	.280	942	62½
90	115.4	10.38	0	725	.315	837	62½
100	115.	11.54	0	722	.352	751	62½
110	113.2	14.45	0	711	.386	685	62½
120	111.	13.32	0	697	.426	627	62½
130	105.	13.68	0	660	.456	579	62½
140	Belt	sprang	off pulley.				

Four inches more were then cut out of the belt, which brought it together with a strain of 83 1-3 pounds per inch, with these results:

Load on Brake, lbs.	R. P. M.	H. P.	Slip.	Ft. Belt per min.	Coeff. Friction.	Ft. Belt per H. P. per in.	Strain per inch in lbs.
80	114.3	9.14	0	718	.210	944	83⅓
90	114.3	10.20	0	718	.237	837	83⅓
100	114.3	11.48	0	718	.263	754	83⅓
110	113.2	12.45	0	711	.290	685	83⅓
120	113.2	13.58	0	711	.315	628	83⅓
130	112.1	14.57	0	704	.341	580	83⅓
140	111.	15.54	0	697	.363	538	83⅓
150	109.	16.35	0	685	.387	505	83⅓
160	109.	17.44	0	685	.426	471	83⅓
170	106.7	18.14	0	670	.447	443	83⅓
180	103.4	18.61	0	650	.472	419	83⅓
190	Belt	sprang	from pulley.				

This last trial seemed to exhaust the capacity of the belt, as the rubber had begun to peel from the canvas and prevented any further trials.

TABLE II. COTTON LEATHER BELT.

IRON PULLEYS.

Load on Brake, lbs.	R. P. M.	H. P.	Slip.	Ft. Belt per min.	Coeff. Friction.	Ft Belt per H. P. per in.	Strain per inch in lbs.
100	120.	12.	0	754	.262	754	83⅓
110	117.6	12.94	0	739	.289	695	83⅓
120	116.5	13.28	0	732	.315	628	83⅓
130	115.4	15.	0	725	.341	580	83⅓
140	114.3	16.	0	718	.368	538	83⅓
150	113.2	16.98	0	711	.394	502	83⅓
160	111.	17.77	1.00	707	.415	477	83⅓
170	110.	18.70	2.22	707	.436	453	83⅓
180	109.	19.62	3.11	707	.458	432	83⅓
190	107.1	20.35	4.80	707	.475	418	83⅓
200	105.3	21.06	6.40	707	.491	403	83⅓
210	100.	21.00	9.	691	.500	394	83⅓
220	95.2	20.95	13.	688	.506	394	83⅓
230	88.2	20.29	15.	659	.507	393	83⅓

Belt still on pulley, but power exhausted. Maximum at 200 lbs. load.

WOODEN PULLEYS.

Load on Brake, lbs.	R. P. M.	H. P.	Slip.	Ft. Belt per min.	Coeff. Friction.	Ft. Belt per H. P. per in.	Strain per inch in lbs.
120	120.	14.40	0	754	.315	628	83⅓
130	120.	15.54	0	746	.342	580	83⅓
140	118.8	16.62	0	746	.368	538	83⅓
150	117.6	17.64	0	739	.394	503	83⅓
160	116.5	18.64	0	732	.420	471	83⅓
170	115.4	19.55	0	725	.444	444	83⅓
180	115.4	20.70	0	725	.470	420	83⅓
190	114.3	21.70	0	718	.499	397	83⅓
200	113.2	22.64	0	711	.525	377	83⅓
210	113.2	23.77	0	711	.557	359	83⅓
220	112.1	24.66	0	704	.579	342	83⅓
230	112.1	25.78	0	704	.605	328	83⅓
240	111.	26.64	0	697	.634	314	83⅓
250	111.	27.75	0	697	.660	301	83⅓
260	107.2	27.87	0	673	.684	290	83⅓
270							

The next tests were of a "cotton-leather belt," so called, which was first cut 31 feet 2 inches long and weighed 37¼ pounds. I will not quote the trials of this, under a light strain, but proceed at once to that of 83 1-3 pounds per inch, in order to get which we had to cut out the length of 3¼ inches. Table II gives the results of the tests under those conditions on both iron and wooden pulleys, the brake load of 270 pounds "stalled" the engine, without any apparent slip of belt, and it was decided to reduce the width of the belt and try further. As the lace holes happened to be punched we could not well cut to even inches, but took off 3½ inches, making the belt 8½ inches wide, relaced it and tested again. This gave the initial strain of 117.6 pounds per inch, which gave on wooden pulleys:

TABLE III.

WOODEN PULLEYS.

Lbs. on Brake.	R. P. M.	H. P.	Slip.	Ft. Belt per min.	Coeff. Friction.	Ft. Belt per H. P. per in.	Initial Strain, lbs.
130	120.	15.6	0	754	.341	430	117.6
140	120.	16.8	0	754	.357	382	117.6
150	117.6	17.64	0	739	.394	366	117.6
160	116.5	18.64	0	732	.420	323	117.6
170	116.5	19.72	0	732	.444	316	117.6
180	115.4	20.77	0	725	.472	297	117.6
190	114.3	21.71	0	718	.500	281	117.6
200	113.2	22.64	0	711	.525	267	117.6
210	113.2	23.77	0	711	.551	254	117.6
220	111.	24.42	1.08	705	.572	245	117.6
230	111.	25.53	1.08	705	.600	234	117.6
240	105.3	25.27	0.95	668	.624	222	117.6
250	Belt	slipped	off driver.	Engine	slowed	down.	

PAPER PULLEYS.

Lbs. on Brake.	R. P. M.	H. P	Slip.	Ft. Belt per min	Coeff. Friction.	Ft. Belt per H. P. per in.	Initial Strain.
130	120.	15.64	0	754	.342	414	117.6
140	120.	16.80	0	754	.368	382	117.6
150	118.8	17.82	0	746	.394	356	117.6
160	118.8	19.	0	746	.423	333	117.6
170	117.6	20.	0	739	.446	316	117.6
180	116.5	20.97	0	732	.472	297	117.6
190	115.9	21.93	0	725	.500	283	117.6
200	114.3	22.86	0	718	.523	267	117.6
210	113.1	23.73	0	711	.550	254	117.6
220	111.	24.42	0	697	.578	242	117.6
230	110.	25.30	0	691	.602	232	117.6
240	101.4	24.40	6.30	675	.595	237	117.6
250							

Engine slowed and belt slipped off driver. Weighed again and strain found the same = 117 pounds per inch.

It will be seen by these figures that the 8½-inch belt developed nearly as much power as it did at 12 inches, and was entirely uninjured by the increased strain. It simply exhausted the engine, and showed no signs of wear or stretch. This shows a remarkable uniformity of friction between the wooden and paper pulleys. It must also be remembered that with this belt the soft side of the leather was in contact with the pulley.

We next took the new leather belt, which, it will be remembered, was quite raw and stiff, and cut that down to the same width and tried it, grain side to pulley, under the same strain of 117.6 pounds. The results were:

TABLE IV.

WOODEN PULLEYS.

Lbs. on Scale.	R. P. M.	H. P.	Slip, per cent.	Ft. per min.	Coeff. Friction.	Ft. per H. P. per in.	Initial Strain.
80	114.3	9.14	0	718	.210	667	117.6
90	113.2	10.19	0	711	.227	593	117.6
100	109.	10.90	1.09	692	.260	514	117.6
110	107.	11.70	3.77	699	.280	503	117.6
120	Slipped.						

PAPER PULLEYS.

Lbs. on Scale.	R. P. M.	H. P.	Slip, per cent.	Ft. per min.	Coeff. Friction.	Ft. per min.	Initial Strain.
80	117.6	9.41	0	739	.210	667	117.6
90	116.5	10.48	0	732	.236	593	117.6
100	115.4	11.54	0	725	.262	534	117.6
110	115.4	12.60	0	725	.290	485	117.6
120	114.3	13.72	0	718	.315	445	117.6
130	113.2	14.72	0	711	.341	411	117.6
140	112.1	15.69	0	704	.367	382	117.6
150	110.	16.5	1.09	697	.391	359	117.6
160	108.	17.28	4.	707	.404	348	117.6
170	Slipped	off pulleys as before at reduced speed.					

In this last trial it will be seen that the paper pulley showed a decided advantage over the wooden one, but the belt had probably been softened and become flexible by the previous trials. We then took the "rawhide belt," which had shown

such goods results previously and cut that down to 8½ inches and tried on wooden pulleys as follows:

TABLE V.

WOODEN PULLEYS.

Lbs. on Brake.	R. P. M.	H. P.	Slip, per cent.	Ft. Belt per min.	Coeff. Friction.	Ft. per H. P. per inch.	Initial Strain.
80	120.	9.60	0	754	.210	667	117.6
90	120.	10.80	0	754	.240	635	117.6
100	117.6	11.76	0	739	.268	534	117.6
110	115.4	12.69	0	725	.289	485	117.6
120	115.4	13.75	0	725	.312	448	117.6
130	114.3	14.86	0	718	.342	401	117.6
140	114.3	16.	0	718	.368	385	117.6
150	113.2	16.98	0	711	.394	355	117.6
160	113.	18.08	0	710	.420	333	117.6
170	111	18.87	0	697	.446	314	117.6
180	111.	19.08	0	697	.476	297	117.6
190	111.	21.09	0	697	.500	280	117.6
200	110.	22.	0	691	.525	269	117.6
210							

It was then tried on the paper pulleys, as follows:

Lbs. on Brake.	R. P. M.	H. P.	Slip, per cent.	Ft. Belt per min.	Coeff. Friction.	Ft. per H. P. per in.	Initial Strain.
90	122.4	11.02	0	769	.358	592	77.72
100	121.2	12.12	0	761	.398	503	77.72
110	120.	13.20	0	754	.438	486	77.72
120	120.	14.40	0	754	.477	445	77.72
130	118.8	15.44	0	746	.517	411	77.72
140	117.6	16.46	0	739	.557	382	77.72
150	115.4	17.31	1.87	739	.585	352	77.72
160							

Slipped off, with slight warming. Put back and strain weighed, before unlacing. Found to have shrunk from 117.6 pounds to 77.6 per inch. The belt was probably overstrained and stretched in the last trial on the wooden pulley, when it showed one horse-power per inch for 269 feet speed per minute. It will be seen that the paper pulley gave rather better results than the wooden one until the belt flew off.

It should be noticed that all the pulleys were "crowned" ⅛ inch to the 12-inch width. This completes the record of comparative tests of pulleys, but I have others bearing on another question, viz., the amount of slip, caused by entrained air, which may be interesting, although not as yet very conclusive.

My attention was drawn to the following subject more than fifty years ago in starting up a large woolen mill, in the construction of which I had been engaged.

A large vertical belt, about 36 inches wide, rose from the basement to the sixth story, where it carried about 240 H.P. and had a heavy "binder" resting on it to take up slack and keep it in close contact with the driven pulley, which was 5 or 6 feet in diameter.

The explosion of the entrained air at this pulley was something like that of a bunch of Chinese firecrackers, and the electricity generated was such that the overseer of the room placed a wire in contact with the belt and amused himself by lighting up his nearest gas burner. Taking the wire in one hand and holding a finger of the other to the burner it gave a slight but not unpleasant shock.

Experiments have been made to get rid of this accumulation of air, by perforating either the belts or the pulleys, and I have made some trials of perforated belts. In the apparatus used the shafts were on the same level, so that the belts were horizontal, and were 12 feet from center to center.

The driving pulley was 30 inches in diameter, and the driven one 12 inches. The belts were cut 29 feet 3 inches long, and were 6 inches wide, and the driven pulley was mounted on a frame sliding on "ways," which could be drawn up to give the desired tension. The weights in scale were applied to a lever, which was the radius of a 10-foot circle. The "slip" as given is doubtful, as the speed of the "driver" was determined by an assistant, with a common speed counter, and the speed was very irregular, owing to deficiency of engine power and the throwing on and off of other machinery.

In previous trials an automatic counter was used, consisting of a dial and index attached to the driving shaft, which could be read easily at the strokes of a bell, which was rung every 100 revolutions of the driven shaft, but this could not be applied in this case. The first belt quoted was a light double one, weighing 21.5 pounds, on iron pulleys, with these results; belt unperforated:

Mr. George L. Crepon, of Philadelphia, puts out a perforated pulley which seems to be admirably adapted for this purpose. Thorough trials will be made of this, a description of which I will give later.

TABLE VI.

Lbs. on Scale.	R. P. M., Driven Pulley.	H. P.	Slip, per cent.	Ft. Belt per min.	Coeff. Friction.	Ft. per 1 H. P. per in.	Initial Strain, lbs.
25	690	17.25	2.	2210	.363	769	58.33
30	612	18.36	13.	2210	.393	724	58.33
30	720	24.9	9.3	2396	.411	600	66.66
35	741	25.9	7.8	2527	.376	585	75.
4	674	26.96	5.6	2245	.396	500	82.⅓

SAME BELT, "PERFORATED" OR "SLOTTED."

Lbs. on Scale.	R. P. M., Driven Pulley.	H. P.	Slip, per cent.	Ft. Belt, per min.	Coeff. Friction.	Ft. per 1 H. P. per in.	Initial Strain, lbs.
25	800	20.	3.8	2613	.444	784	52.
30	706	21.18	5.1	2339	.498	663	62.⅓
35	706	24.71	3.2	2792	.395	556	75.
40	700	28.1	4.	2792	.463	500	75.

DRESSED BELT, WITH PAGE CO. DRESSING.

Lbs. on Scale.	R. P. M., Driven Pulley.	H. P.	Slip, per cent.	Ft. Belt, per min.	Coeff. Friction.	Ft. per 1 H. P. per in.	Initial Strain, Lbs.
35	822	28.77	4.4	2700	.586	563	50.
40	770	30.8	2.	2475	.411	482	83.⅓
45	750	33.75	4.	2440	.455	425	83.⅓

These trials do not show any very great advantage in the perforations, but the speed was not high enough to entrain a great quantity of air, and was so irregular as to make observations difficult.

At the time I was making the previous trials, some years ago, there was a great craze about an abortion known as a link-belt, and the belt-makers were "tumbling over each other" in their eagerness to devise some new form in which they might utilize their scrap leather in this way. After trying a 12-inch belt of this kind I found it so heavy, 196 pounds, that it nearly shook down the counter-shaft, and after shoring and bracing that up it slipped off and caught against a hanger.

* * *

EFFECT OF SOAP IN HARDENING WATER.

In reply to the question, "Why is it not possible to temper steel in soapy water? R. A. McDonald, of the Crescent Steel Co., gives the following explanation in the last number of "Sparks from the Crescent Anvil":

Without going into the chemistry of the subject, the simple answer is: Soapy water is a non-hardener because it does not rapidly abstract or conduct heat from the object to be hardened, and, secondly, it produces a heavy scale which sticks tightly to the surface, the scale being oxide of iron, and this formation is the main preventive.

An interesting experiment to determine the action of soapy water is to prepare two samples of steel of the same area, say one inch round, and turn them to seven-eighths round; also provide two buckets of water, one fresh and the other soapy, say about five per cent. soap.

Then heat both samples up to the same degree of heat as nearly as possible, and plunge one into the fresh water and the other into the soapy water at the same time.

As soon as the red disappears from the one in the fresh water withdraw both from their respective baths and note the appearance of the two pieces. The one that has been in the soapy bath will brighten up and show a reddish heat, while the sample that was chilled in the fresh water will come out black, showing, as far as the experiment goes, that one bath will absorb the heat from the steel much faster than the other, and that consequently one piece becomes hard while the other is left soft.

To carry the experiment farther, reheat the two samples up to the proper hardening heat and then quench them the same as before, allowing both pieces to remain in their respective baths until cold. Examine the surface of each piece when withdrawn and quite a contrast will be observed. The fresh water hardening will show very little, if any, scale, and what there is will be quite thin and loose. The sample from the soapy water will show a heavier scale, and usually it will stick tight to the steel—an oxide of iron has formed on its surface.

CHEMISTRY IN MACHINE SHOP PRACTICE.

A LIST OF CHEMICALS AND THEIR USES IN PRACTICAL WORK.

WARREN E. WILLIS.

Chemistry is that branch of Natural Science that considers the properties and composition of material substances. The name itself is supposed to be of Arabic origin, as are many of the names and terms used therein, as alkali, alcohol, borax, elixir, etc. It is not a science of recent times, as is often considered, but it, or its antetype, Alchemy, dates back to the earliest records of the ancients.

Many chemical facts were known to them, as is evidenced by the smelting of ores and working of metals without which but few of their works of art, still existant, could have been made.

They made articles of glass and understood the coloring of it; the Damascus blade, the Royal Purple dye, the articles of bronze as found in recent excavations, the Chinese vases, centuries old, and Egyptian monuments and mummies, all bear silent witness to their skill in these things of long ago. Yet such science as theirs was probably not the result of patient experimental investigation, but rather isolated facts, the result of mere accident, handed down from one generation to another.

The underlying basis was not understood, as can be clearly seen in the fact that for centuries vain attempts were made to change the so-called baser metals into those esteemed as noble: as iron and lead into silver and gold, or to find an elixir capable of prolonging human life and thus pervert the laws of nature; but the philosopher's stone is not to be found, either to permute metals or prolong life.

The political conditions of France towards the close of the last century exerted a strong influence upon the progress of chemistry, especially in its application to the arts and sciences and its diffusion as a branch of popular knowledge. For when that country, accustomed as it had been to purchasing its most important munitions of war, was cut off from outside communication and was compelled to defend itself from all Europe, scientific men, especially chemists, were called upon to produce means for creating the material of war on which the life of the nation depended.

When order was again restored new institutions were formed for instruction, in which the study of mathematics and physical science were made especially prominent.

The influence which these schools have had in diffusing chemical knowledge has been highly important; since the latter has become a matter of popular education, the methods of teaching it have been made subjects of special study and have been greatly improved.

The immense influence which chemistry now exerts upon all arts and manufactures is characteristic not only of the science itself, but of civilization and the intelligence of the nineteenth century. The reason why bread rises, electric bells ring, iron rusts, ice forms and thousands of other every-day occurrences are surely interesting.

A List of Chemicals.

It is believed that the majority of mechanics, without being specially informed on the subject, divide all chemical substances, either fluid or solid, into two classes: rust producers, represented by corrosives, such as most acids, on the one hand, and on the other substances which neutralize such action, as alkalis of various kinds.

For ordinary practical purposes this is mainly correct, but far from specific; a wider and more definite knowledge of chemicals and chemical combinations, it is believed, would tend to benefit the mechanic, be he employer or employee.

The following list of chemicals and other substances, together with a brief statement of their main shop uses, and sources from which they are derived, may possibly be of interest:

ALCOHOL is made from a variety of vegetable growths, especially grains; the crushed and moist particles of the substance is termed a mash and permitted to ferment, and from that stage the alcohol is withdrawn by distillation.

It is a strong dissolvent, readily cutting most oils and gums, thus finding extensive use in lacquers and varnishes and for cleaning purposes; it is highly volatile, and should be well stoppered; it burns with a clear, strong flame, without smoke, producing a large amount of heat, due to the carbon it contains, and is used largely in blow-pipe lamps. Possessing, as it does, antiseptic properties, cut and bruised parts of the human body may be cleansed and stimulated by external applications.

Wood alcohol is a by-product of charcoal, making destructive distillation; its comparative low cost causes it to be used for many purposes where its disagreeable odor is not objectionable; it has all the properties of grain alcohol and is nearly as colorless.

AQUA AMMONIA is a colorless liquid, possessing a characteristic and strongly pungent smell; it is a powerful alkali, useful in neutralizing acids and acid strains or burns, and restoring to fabrics their original color; it has strong cleansing properties, rendering it of great domestic utility; at the same time being used extensively in the manufacture of artificial ice.

It is produced on a large scale by treating the ammonical liquor of the gas works with slaked lime and heating the mixture, the resulting gas being dissolved in water, which at 60° Fahrenheit will absorb about 750 volumes of the gas; in this state it is the aqua ammonia caustici, spirits of hartshorn or liquid ammonia of commerce.

Acids.

Acid, Acetic, is a vegetable acid, the foundation of most of the domestic "sours," as vinegar, wines, etc., and cooling (?) summer beverages. Acid, Boracic or Boric, is obtained from the collected and concentrated gases and fumes from volcanic springs in Tuscany. It is used in making Borax, and is also employed in increasing the whiteness of silver alloys and in decomposing the sub-salts deposited in electro-baths containing potassium cyanide.

Acid, Hydrochloric or Muriatic, is made by heating together, in an iron vessel, common salt (sodium) and sulphuric acid; the acid, which is a gas, is given off and dissolved in water, which will absorb 460 volumes of the gas. It is used on a large scale as a by-product, in the manufacture of soda, and finds extensive industrial applications, such as the pickling of iron and brass castings.

Acid, Nitric, usually made from powdered nitre and sulphuric acid, is a powerful caustic, unstable and subject to spontaneous explosion, being used in combination with muriatic acid. It is used largely in the manufacture of celluloid, cellulose, gun cotton and several high explosives.

It is very powerful in oxidizing or dissolving all metals except gold and platinum; nearly all metalloids, like sulphur, phosphorus and carbon are converted by it into their corresponding acids; it readily destroys all organic substances.

A mixture of one volume of nitric acid and three volumes of hydrochloric acid is known as aqua regia, and is able to dissolve both gold and platinum, which neither acid will do alone.

Acid, Oxalic, is found universally throughout the vegetable kingdom, oxalates being in the juices of all plants at some time during their growth, notwithstanding that it is a most powerful poison; it is made commercially from starch or sugar, heated with nitric acid, and is used in removing ink, iron rust and other stains from the hands or fabrics; also in purifying and bleaching shellac and similar gums.

Acid, Picric, while a poison if taken into the system, has the remarkable property of soothing and healing burns when applied externally, and should be in every foundry and shop where such accidents are likely to occur; it is of a bright yellow color, has a bitter taste, with no smell. Made from nitric acid and vegetable substances.

Acid, Sulphuric, when concentrated, is a thick oily fluid; nearly all metals are attacked by it; it is a very strong acid, and when heated expels most other acids from their salts. It unites with water with the evolution of heat; this explains the charring of wood, from which it withdraws the oxygen and hydrogen in order to form water. It is found useful for drying gases, and is used largely in foundries, diluted with water, to loosen the scale and sand.

Large quantities are prepared from rock sulphur (brimstone) and lime roasted together in retorts, the escaping vapor forming the article of commerce.

Miscellaneous Chemicals.

BENZINE is a highly volatile product of petroleum or mineral (rock) oil, and is made use of in cleansing fine machinery, etc.;

it possesses the property of rapidly dissolving grease, paint, etc., and bringing the metal surfaces to their original appearance.

BORAX, while a natural deposit, occurring in several places on both continents, is prepared also artificially from boric acid and soda, and is used extensively as a solvent for metallic oxides and as a flux in welding and brazing operations; also in glass manufacture and in the preparation of glazes for pottery.

It has strong cleansing properties, adapting it to many domestic purposes, and may be used as an antiseptic for the preservation of food and in medicine.

CARBORUNDUM is an artificial product of the electric furnace acting upon clay; the grains produced are next in hardness to the diamond, being superior to emery; it is used in the same manner as emery, which it would largely supersede if an efficient bond be found for it.

CORUNDUM is a mineral—alumina—remarkably hard, a species of gem stone, of which emery is a variety; it is used as an abrasive in polishing and grinding.

CROCUS is but the finely divided particles of oxide of iron-red rust; used as an abrasive for polishing and sharpening.

CUPRIC SULPHATE, Sulphate of Copper, Blue Vitriol, and Blue Stone are but the several names of the same thing; it is obtained by roasting the copper sulphite ores (copper pyrites); the result, dissolved in water, produces the semi-transparent blue crystals of commerce.

The sources of supply are Russia and the Lake Superior region of the United States; it is used in dyeing, electroplating, plain coppering—the machinists' well-known solution—and prevention of decomposition of organic substances.

CHALK is a calcareous deposit of infinitesimally small shells, of which England is the chief source of supply, nearly the entire island being underlaid with it. When finely ground it becomes Whiting.

EMERY is obtained principally from the islands of the Grecian archipelago; its hardness depends upon the amount of iron and silica in its composition.

It is of the same mineral species as many of the Oriental precious stones, such as rubies and sapphire, but of a dense, opaque, dull bluish or brownish black color.

MERCURY, a true metal, obtained from the quicksilver mines of Russia, practically a fluid, has a strong affinity for other metals, forming with them what is called an "amalgam"; it is used on electric-battery plates, electro-plating, for silvering mirrors, etc.

POTASSIUM CYANIDE, a powerful poison, having an odor similar to prussic acid, is a white, easily fusible substance, crystallizing in cubes, which easily deliques in the air; it is the indirect product of finely divided iron and animal matter heated to redness, usually obtained during the manufacture of potassium prussiate.

By fusing, potassium cyanide reduces many metallic oxides and hence is employed in reduction processes; it is also used in photography, in glavanic plating, and as an agent in hardening, leaving the surface of the metal in a clean, white condition, the results being the most satisfactory of any of the substances usually employed.

PRUSSIATE OF POTASH, or, more properly, the Ferrocyanide, being somewhat cheaper, is frequently used in place of the above, in hardening operations, the properties being nearly the same, but the work being discolored and uncleanly. It is prepared commercially by igniting carbonized nitrogenous animal matter (blood, horns, hoofs, leather, offal, etc.) with potash and iron.

Common Salt, or CHLORIDE OF SODIUM, is gained from the sea and natural deposits in many countries; its use for mechanical purposes is principally in hardening, a solution of brine having a greater affinity for iron than fresh water, causing it to take hold quicker on the hot metal and without forming air bubbles, thus causing soft spots; the work should be well washed in fresh water, otherwise the salt is likely to cause the metal to "oit" and rust.

SAL AMMONIAC is the product of the ammoniacal liquor—a by-product of gas manufacture, treated with hydrochloric acid, and is used in welding, brazing, soldering and making "rust joints."

SODA—Sal Soda—is made from ashes, but more largely from the decomposition of common salt; used quite extensively dissolved in water—preferably kept hot—to remove grease, oil and dirt, and being capable of neutralizing acids acts as a rust preventative. A saturated solution is also used in machining wrought iron, producing the so-called water-polishing effect. By its combination with and affinity for grease, it readily froms a soap and is indispensable where cleanliness is desired.

* * *

A THREE-CYLINDERED SHOP MOTOR.

The somewhat novel form of motor shown in the accompanying engraving, Fig. 1, is one that was built a few years ago in the Fallbrook shops at Corning, N. Y., under the supervision of Mr. C. R. Williams, who at that time was the general foreman of the engine repair work. This engine was designed and built to meet the demand for a portable form of motor that could be easily transported and which could be set up with a minimum of labor and easily made ready for the operation of such tools as desired. The selection of the tripod form of base probably secures the greatest stability with the least weight, and if the work required the addition of more weight it was secured by hanging peculiarly shaped castings on the legs, the supporting pins being shown in the cut.

FIG. 1. NOVEL SHOP MOTOR.

The design of the cylinders and valve-gear is considerably out of the ordinary, and, as will be noted, consists of three cylinders with trunk pistons and piston valves, which have a movement at right angles to the axis of the cylinders. The valves are operated by a single cam through the three levers having rollers at their inner ends. The connecting-rods are all connected to the same crank-pin, so, of course, the single cam will cause the different events necessary for the proper action of the valves to come in their order.

The motor is designed for the use of compressed air and the supply is taken at the bottom of the pipe-ring shown, which distributes it to the three cylinders. The exhaust is allowed to escape at the ends of each of the piston valves, no exhaust-pipe being needed when the medium used is compressed air.

For ordinary work the power is taken directly from the crank-shaft, but if a greater reduction and more power be needed it is secured by throwing in a back-gear, which shows rather indistinctly at the back.

The motor is shown with a Stow flexible shaft attached, which makes a convenient arrangement for drilling or, when attached to the device shown in Fig. 2, a very powerful reaming combination. The idea of the reaming device is clearly conveyed by the sectional view, which shows the ball-bearing worm and the worm-wheel, which has a socket, I, for the square of the reamer. The device being intended to lessen the labor incident to the erection of locomotive work on the pits was arranged to drive the ordinary taper reamers having square shanks which are generally used on hand work. A is the worm, B the worm-

gear, E is a hardened thrust collar, and D is an adjusting screw for the thrust.

Another use which is more suited to the capacity of this motor is the driving of the valve-facing machine, a sort of portable rotary planer that is much used in locomotive work for repairing the abrasive action of the slide valves on their seats that too often run with no other lubricant than that furnished by the steam. The work required of these portable planers in some railroad shops, on account of a mistaken policy which enforces the niggardly use of valve oil, would astonish a person who was only familiar with the conditions under which the ordinary sta-

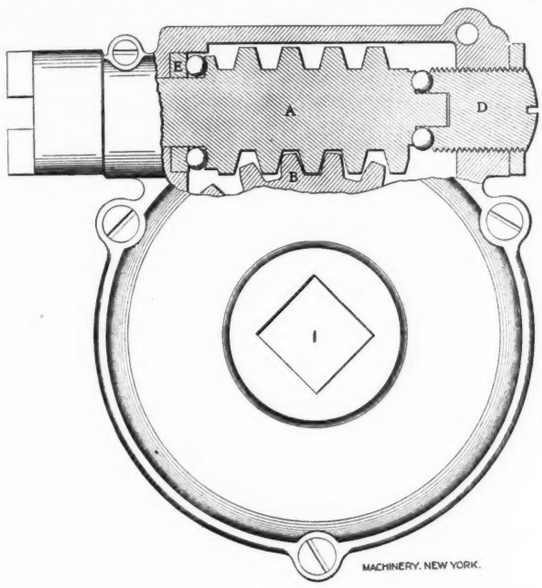


FIG. 2.

tionary engine runs. A valve-seat one inch and a quarter high would ordinarily wear a century in a stationary engine, but for a locomotive it is barely sufficient, in most instances, to last five or six years. In consequence of this a small portable motor for this work serves a very useful purpose in most railroad shops.

* * *

A REVOLVING TOOL-POST.

W. A. BRIGHT.

The accompanying half-tone, Fig. 1, and sketch, Fig. 2, illustrate a form of revolving tool-post which is designed to be used on a lathe having a plain slide-rest which takes the ordinary form of round tool-post with a ring and wedge. The design of this fixture is such that it can be applied or removed very quickly, and, as may be seen, will accommodate four tools.

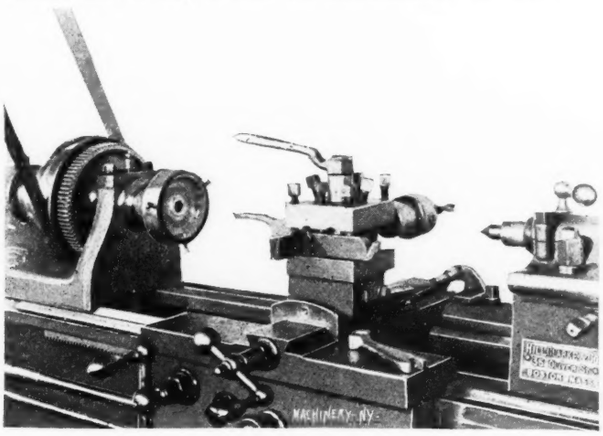


FIG 1.

In its construction a piece of steel was first planed to fit the T slot in the rest, leaving the piece high enough to turn a boss on the top as large as the width of the slot would allow. A block was cast with a groove on the outside surface ¾" deep and ⅜" wider than the lathe steel. A set-screw was put in each corner, and one in the middle of each side, as shown in Fig. 2. The tools could then be held as shown in the photograph or as arranged in the sketch, Fig. 2. A stop is located at the back of the post, which can be adjusted so that a drill or reamer will coincide with the axis of the spindle when the post is against the stop. To accommodate drills, reamers or turret tools, two holes were bored through the block as close together as the binding bolt would allow. The post revolves to the left and has a stop in the under side to locate it in the correct position for each tool.

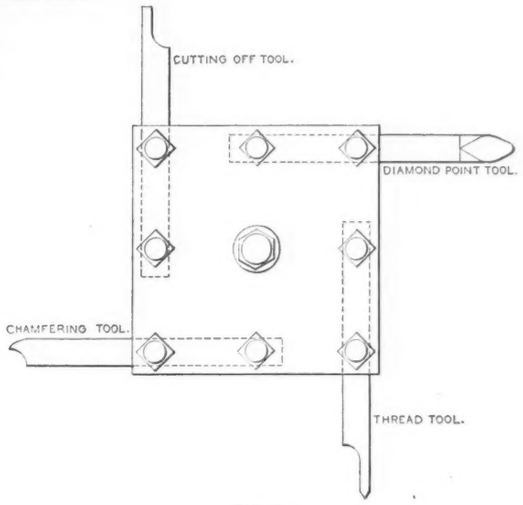


FIG. 2.

On a job that requires to be bored and faced the tools are set as shown in the photograph, Fig. 1, but where the work is all turning, such as making a lot of special screws from the bar, the tools should be set as shown in Fig. 2.

The device shown in Fig. 3 is a block for holding boring tools made of octagon steel, and is made as long as the width of the rest. Two binding screws are provided and two grooves—one for

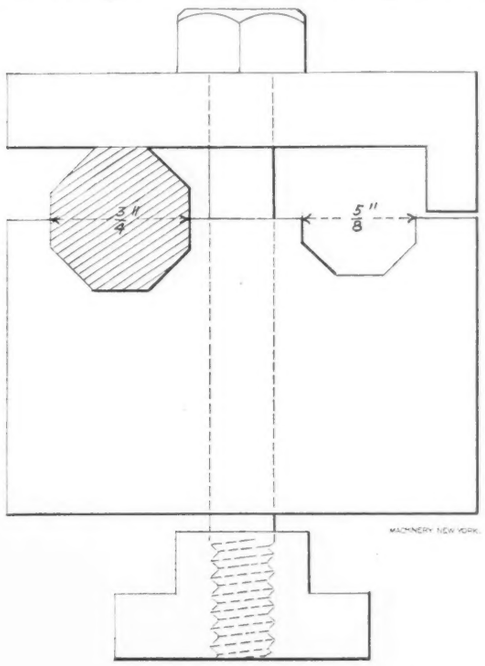


FIG. 3.

¾" steel and the other for ⅝" steel. The boring tools are made to cut on the center line, so it is never necessary to adjust them up or down. By this means I save forging and do not have to use a long tool on a short hole, but can always have the tool the right length of the depth of the hole. Should any of the readers of MACHINERY wish to make a revolving post similar to the one described I will tell them on request how to make the stop which is not shown in the photograph.

About new lathes, we cannot all get them because we are not able, and then, again, because the "Old Man" won't. I always look at the cuts of the new lathes advertised in MACHINERY and sometimes send for catalogues. I look at the pictures and wish that I was in the "Old Man's" place long enough to order one and to scrap the old one.

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SEPTEMBER, 1899.

CIRCULATION STATEMENT.

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The circulation of the three leading papers in the machinery trade, so far as it is possible to obtain the figures, is as follows:

The IRON AGE, about	7,000
The AMERICAN MACHINIST, about	12,000
MACHINERY	18,000

Five years ago this month the first number of MACHINERY appeared, and its readers will probably acknowledge that considerable progress has been made in the interval. An individual who is continually boasting of his achievements and giving other people unsought advice, soon becomes a public nuisance; and as the same rule applies to newspapers we shall keep well outside the chance for criticism in this respect. The figures at the head of this column show what has been accomplished in one direction; but MACHINERY itself is the best evidence, after all. The readers are the real judges, and their decision is shown by the steadily increasing circulation.

* * *

THE NEW SCHOOL YEAR.

This month thousands of young men will begin careers as students in the various schools and colleges Of these thousands many hundreds will elect courses in engineering, and of them a considerable number will take up the study of mechanical engineering.

Most boys, at one time or another, display a genius for mechanics. They like to watch machinery in operation, are clever with tools, and often originate neat devices; people tell them that they are ingenious and that in consequence they ought to study mechanical engineering. We mention this fact because ingenuity is the last thing that should influence a young man in deciding to take a course in mechanical engineering. All boys are more or less ingenious; it is a common trait in youth, but unless it is coupled with certain individual characteristics that are of more importance, it will be of very little assistance in helping to become a mechanical engineer.

Another mistaken impression that seems to be quite prevalent is that whatever pertains to machinery or mechanics is of a superficial character, requiring no deep study, and is easily mastered by anyone. The list of worthless inventions patented by men who imagine they have grasped this or that principle in mechanics without study or investigation, shows how many have held this view. Few appreciate the depth and breadth of the mechanical engineering profession and what is required in the way of work, study and experience to attain distinction in it.

A student who is commencing a college course in mechanical engineering should be prepared for hard, persistent work. The ability to work constantly and hard is the main qualification required, and we unhesitatingly put this ahead of inventive faculty or even a natural liking for machinery.

A brief consideration will show why this is so. An engineer, in the first place, is supposed to be a competent designer, and to be somewhat familiar, at least, with several lines of machinery. The mere proportioning of the parts is not the only consideration. If it is a steam engine, he must understand the principles of steam; if a gas engine, the principles of the internal combustion motor; if a refrigerating machine, the principles of refrigeration; if a pump or a turbine, the principles of hydraulics; if a boiler, the principles of combustion; and if a crane, the strength of materials. Subjects like these, in addition to the fundamental principles of mechanics, form the line of study that one must carry through before he can receive his degree at college and many of the subjects will be found mathematical and uninteresting to the majority of students.

First and last there is a great deal of fault found with the technical schools because the graduates do not always take hold of practical work with the degree of success that they ought to after four years of study. If these criticisms are justified, it is probably because the professors fail to impress their students with the importance of getting into touch with actual machine construction during their course of study. To the "ability for hard work," we should add "the determination to obtain practical work" in connection with the theoretical studies that are given. Workshop practice or experience is needed by every student to complete his education. He can, if he will, obtain part of this during his vacation, and we are glad to note an increasing tendency on the part of students to do this. This experience is of immense value in designing. It gives a familiarity with machinery that can be obtained in no other way, assists one in the maintenance or operation of machinery and gives a knowledge of the precision of measurements that no physical laboratory can give. Shop experience is the stepping stone to responsible positions of management, to consulting practice and designing; in fact, to every position of importance that has to do with the construction of machinery, while without this knowledge one is barred from most of them.

Students often follow these courses with no definite aim and without a clear understanding of what they should do to make themselves competent in their chosen profession. The advice given by their instructors, while with the best of intentions, is from the instructor's point of view and is likely to be somewhat different from the advice that would be given by a person who has spent his time in every day commercial work. It is well for a student to view the problem of his lifework from all sides and we would suggest that the first thing to be done is to formulate a "plan of campaign" by obtaining the opinions of men who have been engaged in business, rather than relying entirely upon advice given under the college influence. We believe that in almost every instance such advice will substantiate what we say about the importance of supplementing the college course with practical shop experience before the student can hope to do well in his work after graduation.

* * *

The use of graphite on the threads of bolts and studs when erecting work will insure much less trouble in making repairs, as the threads will not rust and "seize."

MACHINE TOOLS, THEIR CONSTRUCTION AND MANIPULATION.—2.

LATHE FEED AND SCREW-CUTTING MECHANISMS.

W. H. VAN DERVOORT.

In all engine lathes the carriage is moved over the shears by means of the lead-screw or the feed-rod and their connections. The former constitutes a positive drive without possibility of slippage, while the latter is a purely friction drive. The independent feed-rod is frequently dispensed with in small lathes, and the lead-screw made to do its work. In such cases the lead-screw is splined and the feed mechanism is driven from a collar which has a feather engaging the spline and slides over the lead screw. As the feed is engaged by means of a clutch this also forms a frictional driver.

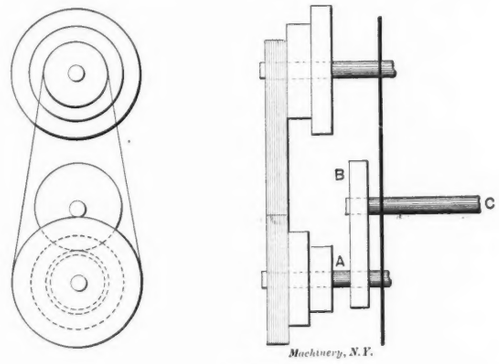


FIG 12.

The feed-rod is driven by belt and provided regularly with three changes of speed. Since it is frequently desirable to have feeds finer or coarser than these three changes can give, it is now quite common to provide either a change gear connection with the feed-rod as shown in Fig. 12 or provisions for connecting the feed-rod with the change gear mechanism of the lead-screw as shown in Fig. 13. In Fig. 12, by changing places with gears A and B, or substituting others any desired speed of feed-rod C can be obtained. In Fig. 13 when gear E is in dotted position the feed-rod is driven by belt in the usual manner. When, however, change-gear feeds are required E is in position shown and is driven by the gear D which is secured on the sleeve A and receives its motion through the change gears F and B. The clutch G, which slides over a key in the lead-screw L is disengaged from the sleeve A, thus preventing the lead-screw from turning while the feed is in operation.

As the carriage must be capable of feed in either direction, a change in direction of motion of feed mechanism must be provided for. This is usually accomplished by interposing an idle gear either in the mechanism of the apron and allowing the feed-

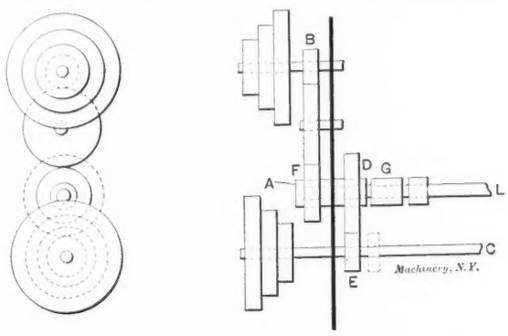


FIG. 13.

rod to rotate constantly in one direction, or in the head-stock gearing. The latter is the more common method in as much as a change in direction of lead-screw rotation is necessary and that cannot be accomplished in the apron. In Fig. 14 is shown the arrangement of gears usually employed. Gear A is secured to the spindle of the lathe. When A gears with B, the direction of rotation of the feed cone is as shown by the arrow. B and C rotate on studs secured in a plate which turns about the axis of D. By throwing the handle H down and C into mesh with A, B becomes inoperative and the direction of rotation of D is changed. The stud G also carries one of the change gears E. The diameter of gears B and C is immaterial, inasmuch as they are simply idlers between A and D, and do not affect the velocity ratio. When gear D is of the same diameter as gear A the stud and spindle have the same rate of rotation. D is, however, frequently made smaller than A, giving the stud a higher rate of rotation.

The mechanism shown in Fig. 15 is frequently employed for reversing the feed in lathes and other machine tools. The feed

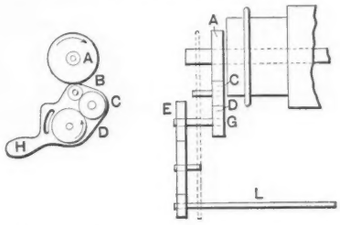


FIG. 14.

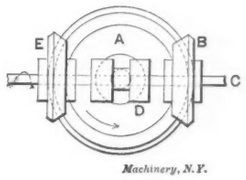


FIG. 15.

rod C carries two bevel pinions B and E and the clutch D. D slides over a key in C and engages either E or B, both of which run loose upon C and mesh with the bevel gear A. When D and E are locked the rotation of A will be as shown by arrow, B turning free on the shaft, and when B and D engage the direction of A is reversed.

The lead-screw is one of the most important parts of the lathe, as accurate screw threads cannot be produced with an inaccurate lead screw. The builders of first class lathes use great care in the production of their screws. The lathe used for cutting them being provided with a carefully cut master screw which is used only for the cutting of lead screws, used on that lathe. The wear on this master screw is therefore very slight and as soon as the lead screw shows signs of inaccuracy the master screw is substituted and a new lead screw for the lathe cut. In this way the standard of the master screw is very closely maintained.

The lead-screw draws the carriage, the force being applied at the nut. It is, therefore, best to take hold of the carriage as close as possible to the shears and thus avoid the tendency to cramp the carriage. In the lathes manufactured by the American Tool Works Co., the lead screw is placed inside the shears in such a manner as to get the most direct pull on the carriage.

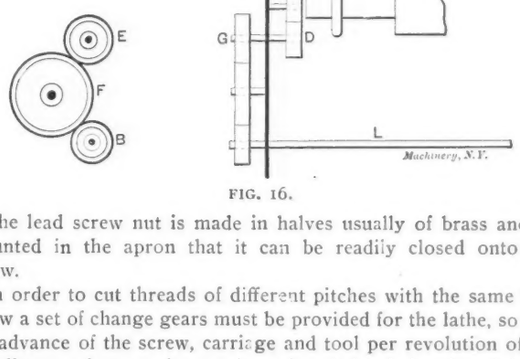


FIG. 16.

The lead screw nut is made in halves usually of brass and so mounted in the apron that it can be readily closed onto the screw.

In order to cut threads of different pitches with the same lead screw a set of change gears must be provided for the lathe, so that the advance of the screw, carriage and tool per revolution of the spindle may be exactly equal to the pitch of the thread being cut. In Fig. 16 is shown the common arrangement of change gear, and generally called a single gear. Gears A, D, and E, and the stud G, correspond to the same parts in Fig. 14, L is the lead-screw, B the gear on screw, and F an idler of any convenient size.

In cutting any number of threads per inch the point of the tool must move along the work an amount exactly equal to the pitch of the required thread for each revolution of the work, thus if the pitch of the lead-screw is 1-6 of an inch and the pitch of thread to be cut is 1-10, it is evident that the lead-screw will make less than one revolution while the work is making one. The tool has advanced 1-10 of an inch and the lead-screw must have rotated through 6-10 of one revolution. If, therefore, the work and the screw were geared together the ratio 6-10 would represent the

ratio of $\frac{\text{teeth in gear on spindle.}}{\text{teeth in gear on screw.}}$ This direct ratio cannot usually be used as the gears A and D are generally of different diameters.

Assume A as having 40 teeth and D 20, then the stud G makes two revolutions for one of the spindle and work. Assume the lead-screw as having six threads per inch, to determine the number of teeth in gears E and B to cut any required number of threads per inch on the work. If six threads are required the screw must make one revolution to the work one, and since gear E rotates twice as fast as the work it should have one-half as many teeth as gear B.

The following general expressions give the ratio of teeth on stud to teeth on screw in problems similar to the above.

$$\frac{\text{Teeth in gear on stud}}{\text{Teeth in gear on screw}} = \frac{\text{spindle rotation}}{\text{stud rotation}} \times \frac{\text{threads on screw}}{\text{threads on work}}$$

With same condition as above, required to cut 12½ threads:

$$\frac{\text{Teeth in stud gear}}{\text{Teeth in screw gear}} = \frac{1}{2} \times \frac{6}{12\frac{1}{2}} = \frac{6}{25}$$

use 18 teeth in stud gear and 75 in screw-gear.

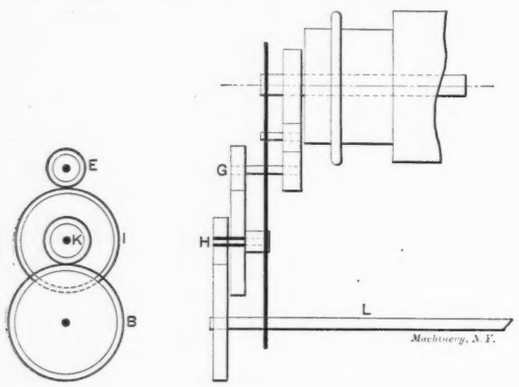


FIG 17.

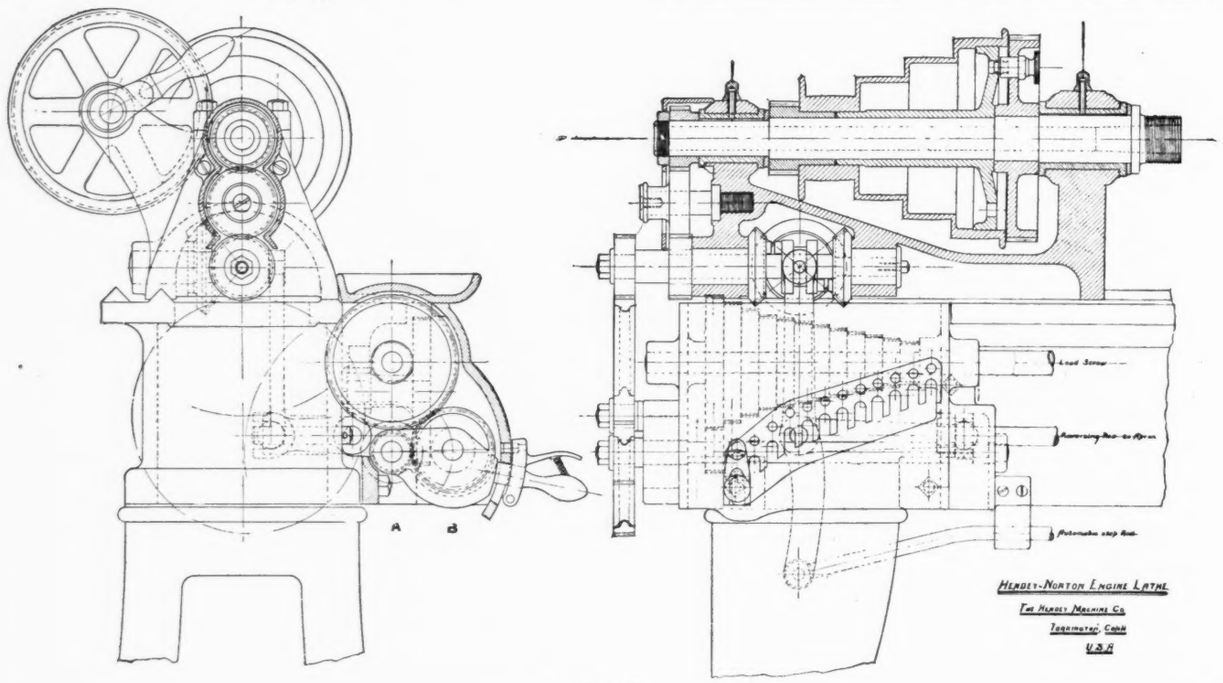


FIG. 18.

Frequently when very wide ranges of screw cutting are desired a compound system of gearing similar to that show in Fig. 17 is used, thus avoiding the use of excessively large or very small gears. In this arrangement H is the intermediate stud. I, the first gear on stud and K the second. This gives two gear reductions in place of one in the single gear shown in Fig. 16. The calculations for determining the proper number of teeth in each gear to cut any thread with the compound gearing involves one more ratio than with the single.

Assuming the velocity ratio of the stud G and the spindle the same as in Fig. 16, and the lead screw ⅛ pitch, we first determine the velocity ratio between the stud G and the lead-screw necessary in cutting the required number of threads per inch on the work. For example, to cut 100 threads per inch we would find the ratios between the stud and screw $= ½ \times 8\text{-}100 = 1\text{-}25$. As we would not care to use a gear having fewer than fourteen teeth on the stud a gear of 350 teeth would be required on the screw if single geared. With the compound gearing, however, we are enabled to divide this ratio into factors $1\text{-}5 \times 1\text{-}5 = 1\text{-}25$. We could therefore use fifteen teeth on gears E and K, and 75 teeth on gears I and B. In like manner if 70 threads were to be cut $½ \times 8\text{-}70 = 8\text{-}140 = 4\text{-}70$, as ratios between stud and screw $= 2\text{-}10 \times 2\text{-}7$, which would give 15 and 75 teeth for one pair and 20 and 70 teeth for the other pair.

Any pair of gears in which the teeth have the required ratio may be used, it of course being desirable to so select the change gears that the greatest possible number of required pitches may be cut with as small an assortment of change gears as possible.

In order to avoid the time lost in changing gears where large varieties of different pitch threads are to be cut, several builders have brought out lathes in which the change gears are all mounted, a change from one to the other being made by a simple lever movement. In Fig. 18 is shown this class of change gear mechanism as applied to the Hendey-Norton lathes. It will be noticed that the change gears are all mounted on the lead-screw and that the auxiliary shaft A is driven through the gear mechanism from the spindle at a fixed velocity ratio with the spindle. Gear B is an idler mounted on the shifting lever and communicates the motion from A to any gear on the lead-screw. In this manner twelve changes in pitch may be obtained without changing gears and for each change in size of gear on A twelve more pitches may be cut.

In this lathe the reversing mechanism of Fig. 15 is applied in the head as clearly shown in cut.

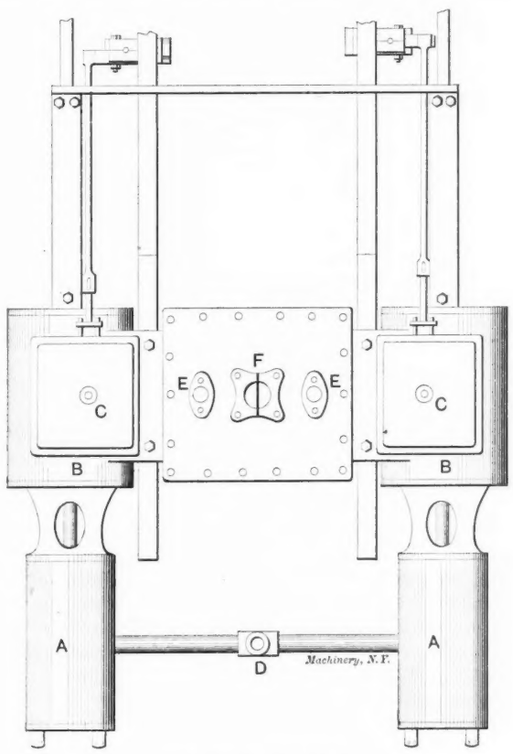
In a mechanism of this character the gears must be rigidly mounted and accurately cut and pitched as otherwise in such long trains the spring and back lash is excessive.

The form of thread usually used on lead screws has sides of about 15° angle, as this form allows for taking up the wear in the nut by closing it onto the screw. The U. S. S. thread is not well adapted as the steep angle of its sides forces the nut apart which is necessarily made in halves.

The lead-screw and nut should never be used for ordinary feeds as the screw would soon loose its accuracy through wear, Unfortunately for the accuracy of the screw a comparatively short portion of its length usually does most of the leading for threads cut in the lathe, and as a result that portion becomes worn and inaccurate while the balance remains in good condition.

A NOVEL AIR COMPRESSOR.

The usefulness of compressed air for shop purposes was naturally quickly recognized by many railroad shops as the air-brake apparatus proved a valuable object lesson showing the convenience and flexibility of this medium. While the efficiency of compressed air for hoists and similar purposes is undoubtedly much inferior to a well-designed hydraulic system, it is nevertheless much preferred on account of the greater freedom from freezing, absence of disagreeable leakage and its adaptability to driving high speed motors. One bad feature about the introduction of compressed air systems into railroad shops has been the proneness to use the ordinary Westinghouse air-pumps in series for air compressors. While the Westinghouse air-pump is undoubtedly an admirable machine for the purpose of supplying air to the brake apparatus of a railroad train, on account of its simplicity and freedom from serious derangement, it is nevertheless, a most wasteful user of steam. As is generally understood, this is a feature practically inseparable from any practical design of pump that does not involve the use of a flywheel as a reservoir of power to supplement the effect of the steam cylinder, as without the flywheel, the steam pressure must at all time be somewhat greater than the resistance of the medium being pumped.



THE AIR COMPRESSOR.

This fact has led the more progressive railroad shops to use air compressors that could be driven from the line shaft, or in many instances, an independent engine and compressor has been installed, but the latter has involved the expenditure of an amount of cash that has been prohibitory in the case of some railroad shops. The way that the Central Railroad of New Jersey shops at Elizabethport, N. J., have secured an independent compressor at little expense is interesting, especially, as their machine undoubtedly under favorable circumstances would show an efficiency equal to any ordinary commercial compressor. They have simply utilized the machinery of an old locomotive for the motive power and have added tandem cylinders to the steam cylinders for the air compressor cylinders. The arrangement is shown in its essential features with the exception of the main driver, by the plan view in the accompanying sketch. The boiler was removed, but the frames and cylinders were left intact with the main wheel, link motion, etc., which were mounted on a suitable foundation. A bearing for the main driver (or flywheel as it now is) was formed by simply turning the driver boxes upside down, the weight of the wheel being found sufficient to hold it down to its proper position since but little power is transmitted through the cranks. Each steam cylinder does the most of its work on its tandem air cylinder, and the feature of rotative action together with the link motion enables the cut-off to be set at the most economical point. As the value of the old locomotive from which the compressor was constructed could only be taken at its scrap price, it is evident that a very cheap and probably effective compressor was obtained.

In the sketch B, B, are the steam cylinders, and A, A, are the air cylinders which have water jackets with a constant circulation. The air delivery pipe is at D, and the steam connections are indicated at E, E, and F, F. The steam and exhaust pipes are not shown, but only the openings in the cylinders.

By a comparison between the summer and winter efficiencies of this compressor, the well known fact was forcibly illustrated that it is highly desirable to take the air supply from as cool sources as possible. This point is too often overlooked in the installation of compressors as in the present case, the air being taken from the engine room where in summer the temperature will range well up into the vicinity of 100° Fahr., and as the storage tank is located in the open air the compressed air is cooled down to the temperature of the surrounding medium.

While there is always an unavoidable loss in the utilization of compressed air under ordinary circumstances, it is perfectly clear that the lower the temperature of the air supply is kept, the less the loss will be from the cooling in the storage tank.

The difference in the work required of a compressor with the air supply at various temperatures can be very easily demonstrated without a very elaborate mathematical demonstration. For an example, we will assume the air supply to have two temperatures for a comparison, one being taken at 60°, and the other at 100° Fahr. The volume of a pound of air at various temperatures and pressures is found by the simple formula

$$V = \frac{30752\ T}{p}$$

so the volume of one pound of air supply at 60° would be

$$V = \frac{.37052 \times 520^{\circ}}{14.7} = 13.107$$

cubic feet. In this calculation the temperature and pressure is absolute so it is necessary to add 460° to 60° which gives 520° and as the air supply is at atmospheric pressure it will have an absolute pressure of 14.7 pounds. The volume of one pound of air at a temperature of 100° would be, as calculated by the same formula,

$$V = \frac{.37052 \times 560^{\circ}}{14.7} = 14.115$$

cubic feet or practically one cubic foot more and if we assume for convenience that the air compressor cylinder has a capacity of one cubic foot, also if we take the respective volumes to be in round numbers 13 and 14 cubic feet, it is evident that 13 strokes of the piston would be required to compress one pound of air at a temperature of 60° whereas 14 strokes would be required to compress the same weight to the same tension when the temperature is 100°. Now if in each case the compressed air be cooled to the same temperature in the storage tank, one-thirteenth of the work expended in the compression is uselessly wasted besides needlessly exposing the cylinder of the compressor to a higher temperature. The above calculation is correct only when no allowance is made for the effect of the cooling device or water jacket, as it is evident the higher the efficiency of the cooling apparatus the nearer the compression line approaches the isothermal curve. If the cooling jacket could attain an efficiency of 100 per cent., it would make no theoretical difference what the temperature of the air supply was.

* * *

Every machinist ought to be a draftsman to the extent of being able to delineate his ideas on paper so as to be clearly understood. A simple sketch will often express more than yards of talk.

* * *

Some manufacturers are very guarded as to their processes and are opposed to the publication of any details connected with their business and then there are others who are always willing to explain their methods without reserve. There are, of course, schemes in every shop that are in a measure private property, but the firms that are to-day doing the greatest amount of business are those that open their shops most freely to those interested.

SHOP KINKS.

A DEPARTMENT OF PRACTICAL IDEAS FOR THE SHOP.

Contributions of kinks, devices and methods of doing work are solicited for this column. Write on one side of the paper only and send sketches when necessary.

JACK FOR STRAIGHTENING SHAFTING.

The rig shown in Fig. 1 is for straightening shafting or other work of a similar nature. It consists of a heavy forged piece A, the plate B, two blocks C C, and the screw D. The method of using the jack is so clearly shown in the sketches that further description is unnecessary.

"G," the contributor of the above kink, says that the crank disc of a large engine was cracked from the crank-pin hole to the outside of the disc but was permanently repaired by shrinking a heavy wrought iron band around the disc and replacing the crank-pin by a new one which was threaded for a nut on the inner end. The combination has proved effective since it was repaired in this manner a number of years ago, but to all appearances is as solid as ever.

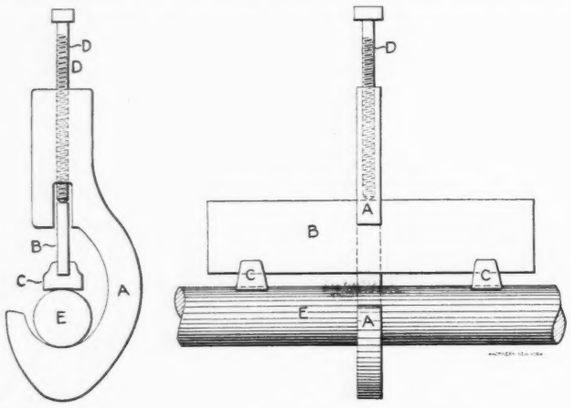


FIG. 1.

TO SAVE LABOR IN MAKING SLOTS, ETC.

Mr. George L. Renneisen of Louisville, Ky., says that a lot of 2½" rods were to be slotted one inch from the end, the slots to be ¾" × 2¼". After laying out the slot on a rod, three holes ¾" in diameter were drilled to remove the stock and then the holes were plugged. The intersections of the three holes were then drilled out and the small ridges filed off with a minimum of labor. It is a common practice with some machinists to chip out the spaces left after drilling the first holes, but by following this practice considerable time and labor is saved.

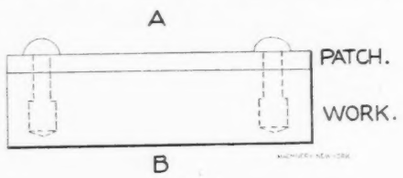


FIG. 2.

A kink that is of considerable value when riveting a piece of brass onto a thick slide or on similar work is to drill the holes for the rivets about two-thirds of the desired depth and then to grind the drill "off center" a small amount. The holes being drilled to the desired depth with this form of drill will be found larger at the bottom than at the top so when a rivet is driven home it expands at the bottom and is there to stay.

SOME BUFFALO KINKS.

Mr. Wm. W. Galloway, of Buffalo, N. Y., says that a useful rig for truing up worn crank-pins is shown at A A, Fig. 3 and that it consists of two blocks of hard wood fitted together with dowels B B and bored out to the smallest diameter of the worn pin. The method of using it consists of covering the interior C with red lead and placing the two parts together over the pin which will thereby be marked with the lead on the high parts. The high parts are then chipped or filed down until the block leaves a uniform coating of lead all around the pin.

While such a method is slow and not as good as removing the pin and turning it in a lathe, it is far superior to not doing the job at all which would usually be the result if the crank-pin had to be removed.

A kink in tapping holes that are so situated that a square cannot very well be used to test the truth of the tap for squareness, is to run a faced nut onto the taper tap, start the tap in the work, and then run the nut E down next to the face of the work G. A wrench F is then placed on the nut to hold it and the tap screwed into the hole with the result that the threads will be square with the face of the work.

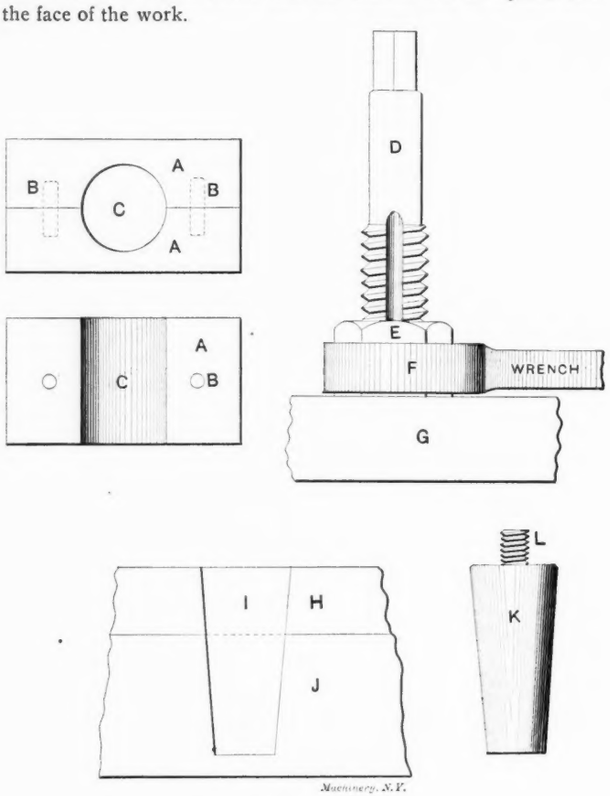


FIG. 3.

If a dowel-pin holding two metal parts, H and J, in a certain relative position becomes lost and it be difficult to take the necessary measurements for making another pin, much time and trouble can be saved by running a babbitt plug into the hole and around a piece of threaded rod as shown at K and L. The interior of the hole should be examined previous to pouring the babbitt to see that it is free from blow-holes which would prevent the removal of the plug after cooling. With such a plug the making of the new dowel-pin is a comparatively easy matter, as all the necessary sizes are at the convenience of the lathesman. The reason for using a threaded rod is that a nut can be used for starting the plug out of the hole should it stick fast.

A RING CUTTING DIE.

"E. J. F.," of Toronto Junction, Can., sends a sketch of a ring cutting die which is designed for cutting off sections of wire coils, the coil being slipped over the die B which has a notch cut for clearance to the cutter A. Different sized dies can be used in the bolster plate C, the change being effected by loosening the set-screw D. "E. J. F." says that he has used the die in the shop where he is employed with great success, and that if the wire is coiled tightly together the rings will come out with their ends truly in line.

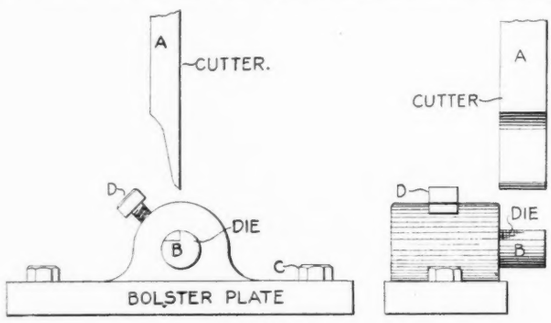


FIG. 4.

CLAMP FOR HOLDING WORK ON FACE PLATE.

J. E. S., of Harrisburg, Pa., says that a useful and handy form of clamp for the face plate of a large lathe is that shown in Fig. 5. At least four should be provided which can be arranged equidistantly around the face plate at the required distance from the center. This clamp is most useful on rings and similar work as they enable it to be firmly held without springing. In the sketch

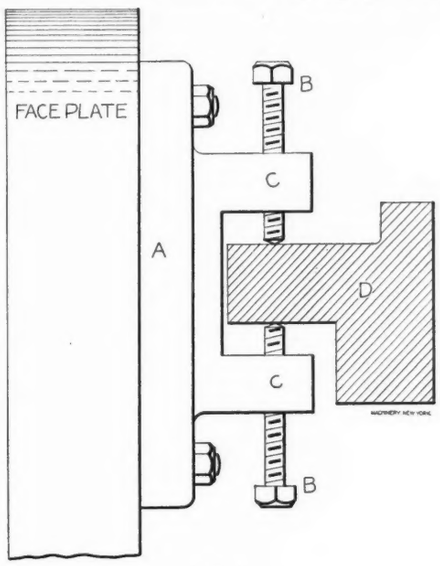


FIG. 5.

A is a casting with two jaws C C, which are tapped for the cupped screws B B. It will readily be seen that a circular piece, having a section like that of D, can be readily chucked with practically no danger from springing if any care is taken by the operator even if the work is of comparatively light character.

* * *

MALLEABLE CAST IRON.*

WHAT IT IS AND IN WHAT RESPECTS IT DIFFERS FROM CAST IRON AND FROM WROUGHT IRON.

Malleable cast iron may be roughly defined as occupying a halfway position between ordinary gray cast iron and wrought iron, as it possesses some of the qualities of both. This definition is not technically accurate, but serves rather to designate the place occupied by malleable iron in the commercial world.

Ordinary cast iron is a very complex alloy of iron with carbon which exists in several forms: Silicon, phosphorus, manganese, sulphur and small proportions of other elements. As we all know, it can readily be cast into intricate shapes. It cannot be bent or forged, and it is brittle under shock, especially in light sections. Wrought iron, in its most refined form, is practically pure iron, and can be easily forged, and can be bent or twisted even when cold without fracture. It cannot easily be cast, but can be welded, a property not possessed by cast iron.

Malleable cast iron, or malleable iron, as it is commonly called, is made from pig iron low in silicon, sulphur and phosphorus, and from which the carbon has subsequently been largely removed by annealing at a red heat in iron ore, mill scale or some other porous or infusible substance. When cast the iron is white in fracture and as brittle as glass, owing to the carbon which is present to the amount of about 3½ per cent., being in chemical combination with the iron. During the annealing at a red heat the carbon, which is at this temperature in a state of solution in the iron, gradually diffuses. As it comes into contact with the surrounding packing it is oxidized and passes off as a gas which can be seen burning at the cracks in the clay luting of the pots. There is a variable amount of carbon retained in the casting, but it exists in a form like graphite in ordinary cast iron; that is to say, it is disseminated throughout the mass somewhat as mica occurs in granite. The flakes of graphite lie between the particles of iron, and form, as it is said, "planes of weakness." The diffusion of carbon in iron, even at a bright red heat, takes place slowly, and hence only castings of small cross-sections can be decarbonized to any appreciable extent. In castings less than ¼ inch in diameter practically all the carbon can be removed.

We have, then, as a result of the two processes, casting and annealing, a product which has first been formed in any desired shape and by its subsequent treatment converted to a state approaching wrought iron. We should therefore expect its physical properties to be between those of cast and wrought iron, and this we find to be the case. Its tensile strength, 45,000 pounds to 52,000 pounds per square inch, is more than cast iron, but slightly less than wrought iron; its elongation of 3 to 7 per cent. is much greater than cast iron, which is practically nil, and much less than wrought iron. We find, on trial, that malleable iron can be bent or twisted and forged to some extent, but not so much as wrought iron. The preceding remarks apply to light work, say to an inch in thickness or less. It is proper at this point to speak of another function of the annealing process as applied to heavy work, such as casting for farm implements and car couplers. As before stated, castings of this class cannot be decarbonized to any appreciable extent, but they are rendered soft and strong. Such articles cannot be bent as much as the decarbonized castings, owing to the graphite forming planes of weakness, as noted above. We have, then, two classes of malleable castings, the small decarbonized articles and the larger articles containing nearly all their original carbon, but in a changed form. Each class of castings is admirably adapted for its own purpose. It may be questioned, if both classes are equally strong and soft, why is it necessary to decarbonize the smaller castings merely to increase their toughness? The answer is that in small work this quality is essential. Many small articles (bits, for instance) are cast open and "closed up" after inserting a ring; or, in assembling bits, parts are frequently upset or headed like a rivet. Thus, for small work it is highly desirable to have decarbonized iron to obtain the bending and cold forging properties.

The first malleable iron castings of domestic manufacture were produced in Newark, N. J., in 1826. Seth Boyden, to whom belongs the honor of doing this, was a native of Foxboro, Mass., but settled in Newark, in 1815, when in his twenty-seventh year. As a boy he worked at farming and occasionally at a furnace operated by one of his uncles. He attended school for only a few short terms, but this by no means ended his education, for he continued his studies by himself, especially in those natural sciences that would aid him in his labors. He showed to a very marked degree the traits of the stock from which he sprang. Mechanical ingenuity and skill with tools came to him naturally. During the course of his long life he was occupied with many of the arts and sciences, and so great were the benefits conferred by his many inventions and improvements on existing processes that the citizens of Newark have erected a statue to his honor.

* * *

A recently patented rotary engine bears a startling resemblance to a style of sausage machine that was quite popular a few years ago. The engine has three rollers, however, instead of two, but the helical flutes with a variable pitch show quite conclusively where the misguided inventor probably obtained his idea. The number of rotary engines patented each year indicate a waste of time and money that might better be directed where the chances of receiving some returns are more promising.

* * *

The electric locomotive constructed by Brown, Boveri & Co., destined for the Jungfrau Mountain Railway, is said to be the most powerful rack-wheel machine hitherto constructed, and is designed to haul trains over the steepest portion of the road. The motors are placed under the passenger cars, whereby greater adhesion between the driving-wheels and rails is obtained. The car truck is provided with two bearing axles and two driving axles, the latter being situated between the former. Two motors, each of 125 H.P., at 800 revolutions per minute, actuate the toothed wheels through the medium of duplicate gearing. If required, these motors are capable of working up to 300 H.P. The driving current is conveyed overhead at a tension of 500 volts. The pivots of the toothed wheels are of aluminum-bronze, the teeth being of cast-steel.

* Geo. C. Davis, in the "Journal of the Franklin Institute."

LETTERS UPON PRACTICAL SUBJECTS.

MAKING IRREGULARLY SPACED REAMERS.

Editor MACHINERY:

Following is a sketch and description of a method for making fluted reamers with irregular spaces, which, whether the reamer is straight or tapered, have the property of lessening the chatter and making smoother holes. The method for spacing the flutes of such reamers is shown by Figs. 1 and 2 and is explained as follows: A list of divisions should be made out which will require an unequal number of turns of the index crank for each indexing, but the sum of these turns must equal the total number of turns necessary to give the work one full rotation. For an ordinary dividing head which requires forty turns of the index crank for one turn of the work, a list of divisions may be made out as below which is for cutting six teeth. The turns of the index crank for the successive flutes are: $5\frac{1}{2} + 6\frac{1}{2} + 6 + 7\frac{1}{2} + 7 + 7\frac{1}{2} = 40$. For dividing with a simple index plate a similar list may be made out.

The cutter should be set so as to leave a proper thickness of land as at E F in Fig. 1, and the relation of the mill to the work should not be altered until the job is complete. The dividing should begin with the smallest number of turns in the list which in this case is 5 1-2, and should be carried through with the different numbers of turns as given in the list.

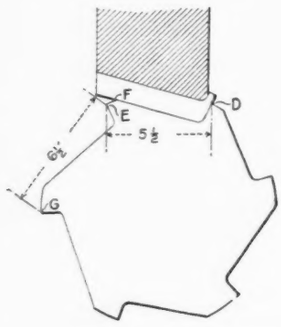


FIG. 1.

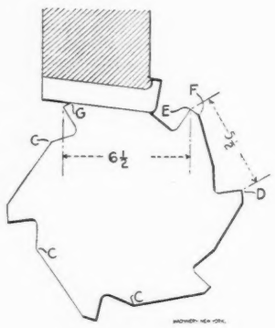


FIG. 2.

Fig. 1 shows the result after going around the work once, the spaces being all of even width but some of the resulting teeth are very thick. The last indexing on the list (7 1-2) will bring the cutter into the first space cut and by indexing in the same order again the cutter would simply pass through each flute without cutting. If, however, after getting around the work the first index is skipped and the cut is started with the index of 6 1-2 turns and continued around the work in the order of the list as given, the lands will all be milled to the same thickness as shown in Fig. 2. The reason for this is that instead of indexing as at first from the face D to E (5½ turns) Fig. 1, by skipping an indexing the work is indexed from point F to G (6½ turns) Figs. 1 and 2, and so on around the reamer. The faces and backs of all the teeth are all at the same angles so that in grinding the reamer to size one tooth will not widen more than another. The slight lumps at C C C, Fig. 2, are readily removed on an emery wheel so that the resulting reamer is scarcely noticeable from an evenly spaced one.

Meriden, Conn. JAMES P. HAYES.

* * *

CHAMFERING CUP LEATHERS, ETC.

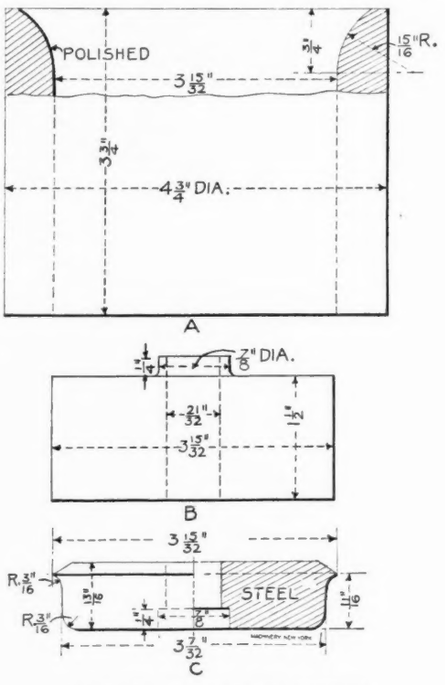
Editor MACHINERY:

I noticed in the July issue of MACHINERY an item about making cup leathers which referred more particularly to chamfering the edges. A blue print is enclosed which shows the way I have been doing it and which makes a beautifully formed cup. A is a sleeve which is bored about 1-32" smaller than the cylinder in which the cup is to work. B is the follower and C is the cup former. The cup former is made of steel of the dimensions indicated in the sketch with the edge R turned to an angle of about 60° and case hardened. The sharp edge of the cup former C being such a close fit in the sleeve A the surplus leather is trimmed off as neatly as if done with a sharp knife and the fillet under the edge leaves a handsome chamfer on the cup leather.

Did any reader ever melt babbitt in a blacksmith's forge and when ready to pour seize the handle in a "hunk" of waste and, at a critical moment, have the hot handle burn through the waste? If so the next time a ladle outfit is made, slip a piece of gas pipe over the handle before bending it. Keep the piece of pipe up next to the handle until ready to carry away the ladle, then slip the pipe down next to the bowl and a cool handle is the result, also a sleeve in which to turn the handle when pouring.

I read with considerable interest the article on step-bearings, as about fourteen years ago I had a little experience with them which may be of interest to some readers. One case was that of an upright shaft in a flouring mill carrying several bevel gears and a number of pulleys making altogether a very heavy affair. The shaft was 4", 3½" and 3" in diameter in its various sections and about sixty feet long with the usual taper steel pin running in a steel step, both of which were hardened and flooded in an oil bath. Although the arrangement was furnished by a prominent manufacturer of flouring mill machinery, there was trouble right from the start and it was necessary to have it sent to the shop every few days until I finally asked the proprietors to allow me to fix it and received their permission.

I raised the shaft about 12", fitted a half coupling on the end and coupled to it a piece of forged iron shaft 5" in diameter and



DIES FOR CUTTING CUP LEATHERS.

12" long. A phosphor-bronze disc 5" in diameter and ¾" thick was made to take the thrust and was secured from turning in the cast-iron box by two 5-8" pins. A groove was cut across the upper face of the phosphor-bronze disc about ⅜" wide and ⅜" deep to insure a plentiful supply of oil to the rubbing surfaces. The usual step-box surrounding the shaft was supplied, holding about one quart of oil.

After the step-bearing was changed in this manner, the miller never had a moment's delay from heating although previously the mill had been nearly fired a number of times by its getting hot.

Another case is that of a "rubbing wheel" in a stone yard with which there was the same difficulty that was encountered in the flouring mill. The wheel weighed about ten tons and the diameter of the lower end of the supporting shaft was 6". The builders had provided a thrust bearing composed of a nest of bronze and steel washers about 3-16" thick (four of each) and running in oil.

I fixed this bearing in the same manner as the mill shaft and results have proved equally as good as there has never been any trouble with it since. E. S. NEWTON.

Fond du Lac, Wis.

ANOTHER SHOP SYSTEM.

Editor MACHINERY:

Having read a number of articles from contributors to MACHINERY in regard to various systems of keeping the time of employees in different shops, I desire to say a few words about the system I have installed in the shop where I am at present employed. The shop I speak of builds a regular line of machines together with a large jobbing business and special machinery. When I entered the employ of the firm the time of each employee was kept by himself. It was kept upon cards blocked into pads with the employee's number at the top, and he was supposed to keep a correct account of his time for each day, write it on one of his cards at night and place the card in a box provided for that purpose. It is needless to say that very little work was done from 5.45 till 6 o'clock, but there always was a great amount of guessing done in that time by each employee as what to put his time down to. It being one of my duties to look the time cards over the following morning it would seem to me his whole ambition was to make sure he had ten hours on his card and let it rest at that. When I came to enumerate the different jobs to be found upon those time-cards I would find ¼ or ½ hour, or possibly more on one job when it should have been on another job. At the same time an employee was allowed to come into the shop at morning and at noon with no one to take his time and no place he could register it. I was constantly being called into the office and nine out of every ten times the two following questions would be asked me: Was so and so in on time this morning? By the way, did number so and so have as much time on the job he was working on yesterday as he had on his time card? I soon got tired of the foregoing dialogue every day, and set myself to the task of installing a time system that would be correct and at the same time not to use fifteen minutes of each workman's time every day in making out time cards. The first move I made was to inaugurate a system whereby each employee might register his time at his arrival and departure. The plan adopted was as follows: I had some cards printed as illustrated in No. 1, I then had two racks made with spaces to fit the card and enough for the number of

Working Time

OF

No. 1. July 29, '99.

Name, Brown.

Day.		In.	Out.	In.	Out.	Total.
M	A. M.	654	1204	653	1207	10
	P. M.	1254	602	1245	603	10
T	A. M.	656	1202	650	1203	9½
	P. M.	130	602	1249	605	10
W	A. M.	700	1201	714	1208	5
	P. M.	.....	.....	1250	608	9¾
T	A. M.	715	1204	7	1205	9¾
	P. M.	1250	605	1250	604	10
F	A. M.	658	1203	640	1204	9
	P. M.	1257	5	1257	601	10
S	A. M.	659	1206	654	1203	9
	P. M.	1257	5	1250	5	9
S	A. M.	.....	.....	.....	.....	.....
	P. M.	.....	.....	.....	.....	.....

Total Hours, 111.
Rate per Hour, .24.
To al Cost, $26.64.

FIG. 1.

men employed. I had these racks placed in an accessible spot and marked one In and the other Out. When an employee entered the shop prepared to work he handed his card to the foreman who registered the exact time he entered, after which he placed the card in the rack marked In; when he left at noon he again presented the card to the foreman who registered the time he stopped work and the card was then placed in the rack marked Out, the same operation being used for p. m. as for a. m. As the shop had pay-days semi-monthly the necessity of using a two-weeks' card was at once evident. As can be seen the card is divided into spaces marked with the first letter of each day, and those spaces are again divided and marked a. m. and p. m. The length of the card is divided into five spaces, the first two marked In and Out are for the first week and the next two marked the same are for the second week, the last one marked Total is for the number of hours. When the employee has registered two weeks on his card it is taken into the office and the number of hours added and placed at the bottom, the employee's rate is placed below and his whole time is figured on his working card. As I stated at the commencement of this article the shop builds its line of tools as well as doing a large jobbing trade, also stating the trouble I had with the men keeping their own time. I then saw the necessity of completing the system and put in use a time card where each employee could

THIS SIDE OUT.
COST CARD.
Job Order, 779.
Cost, ...
Commenced, July 21.
Completed, July 25.

Name of Machine, Bench Lathes.
Names of Parts, Cones.
No. of Machines, 6.
No. of Parts, 6.
Operation, Finish.
Repairs, ...
Order No., 779.

Correct, H., Foreman.

FIG. 2. FRONT.

keep his time on each job correctly. This card I will number 2 for distinction. A regular order book is in use and all jobs, whether for repairs or machines, are written in this book and an order number placed opposite, for example:

July 20,

Weed and Baker,
6 Bench Lathes NO. 779.

Working Time

OF

No. 5. July 21, 1899.

Name, Jones.

Day.		In.	Out.	In.	Out.	Total.
M	A. M.	.....	.....	.....	.....	.....
	P. M.	.....	.....	.....	.....	10
T	A. M.	.....	.....	.....	.....	.....
	P. M.	.....	315	.....	.....	7¼
W	A. M.	.....	.....	.....	.....	.....
	P. M.	.....	.....	.....	.....	.....
T	A. M.	.....	.....	.....	.....	.....
	P. M.	.....	.....	.....	.....	.....
F	A. M.	8	.....	.....	.....	.....
	P. M.	.....	.....	.....	.....	9
S	A. M.	.....	.....	.....	.....	.....
	P. M.	.....	.....	.....	.....	9
S	A. M.	.....	.....	.....	.....	.....
	P. M.	.....	.....	.....	.....	.....

Total Hours. 35¼
Rate per Hour, 20.
Total Cost, $7.05.

FIG. 2. BACK.

An employee goes to the foreman and is out of a job; the foreman wishing him to finish the cones for the lathes in the above order, makes out a time-card (No. 2) with the description of the work to be done and the number of pieces to be finished on one side of the card, on the opposite side he writes the employee's name and number and the exact time it was commenced, and when the work is completed the workman returns his work together with his card and if found satisfactory, the foreman

No. Pcs.	MATERIAL.	Wt.	Feet.	In.	Cost.
.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....
6	Cone castings.	64½	.....	.....	.....
.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....

MATERIAL.

ORDER NO. 779.

Hour	Min.	ISSUED
7	.....	July 21.
		COMPLETED
3	15	July 25.

H., Stock Clerk.

FIG. 3.

writes the time it was finished. The time is then carried out into the space marked Total, again the total is carried to the bottom of the card together with the workman's rate, which is figured and gives the cost of finishing the 6 cones, which is marked on the opposite side. A new card is used for every part, the same being placed on file till the job is completed, when they are

taken all together and figured, the product being the actual cost of the machines; at the same time we have the actual cost of each part. As to the use of the card for jobbing, it gives the actual time on each job as well as relieving me of my morning calls at the office, for the clerk knows the cards tell nothing but the truth. As time went on and I found this system was a success I began to think of putting into operation a system of keeping stock, having at that time become aware that there was a leakage from that source, also to know the actual cost of work I must know the amount of stock used. For that part of the system I adopted card No. 3. When an order came and it was time to start work on same the material to be used was looked after; as seen by card No. 3 the stock was weighed one hour before the foreman signed the time slip. As it passed through the foreman's hands and went to the office the two were compared, showing that the foreman was attending to his business and had the stock weighed one hour before the workman began to finish same. It is part of my duties to weigh the castings for each machine and at any time after I can always find the weight of the machine complete, or of any of its parts by simply referrng to those No. 3 slips.

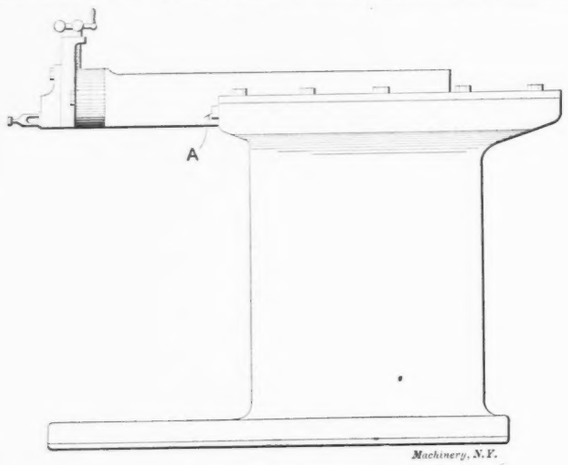
Providence, R. I. A. F. HORTON.

* * *

ABOUT THE FORM OF A SHAPER RAM.

Editor MACHINERY:

I have read with considerable interest the letter in the May MACHINERY by Mr. Hill on "Shaper Designs," and can agree with him that it is highly desirable to obtain a machine in which the shaper ram will be as stiff to resist an upward spring when at the limit of travel as when close to the frame. The utter unreliability of the shaper to produce work which has the feature of parallelism in the opposite sides, is a fatal drawback to a machine



A SHAPER SUGGESTION.

which otherwise would be one of the most useful tools in the shop. Even as it is with the faults of inaccuracy and lack of stiffness in the knee, many shops make extensive use of it on work that does not perhaps require the greatest accuracy. If the shaper could be so built that it would be capable of turning out work as nearly parallel with the surface of the table as that produced by the average planer, it is evident that its field of usefulness would be greatly extended.

While the planer is usually a somewhat massive tool, it does not depend entirely on its strength for the accuracy of the work turned out, but rather on the feature of uniform deflection in the parts that resist the strain imposed on the tool. Practically no machine can be built so stiff and massive that it will not spring more or less under the strain of the cut, but by reason of the form of construction of the planer, the tool while deflected upwards by the work is no more influenced in that direction at the end of the stroke than at the beginning. In the shaper this is not the case however, but the deflection increases with the length of the stroke. Now, since the spring of the ram and a certain slackness in the slides are features that cannot be overcome practically why not attack the problem in a logical manner and start with the assumption that a certain deflection of the cutting tool is unavoidable, but if it can be made uniform the results will be uniform.

The method which I would suggest for accomplishing this desirable result is not to stiffen the ram to an abnormal extent, or necessarily change its form as suggested by Mr. Hill, but is simply to cut off the supporting slides of the ram at the point A even with the frame, when the ram is at its extreme outer position. The result is that while the stiffness of the ram is impaired for work that comes close to the frame of the machine, it is not damaged for operating on work at the limit of the stroke and as the spring of the tool will be uniform at all points in the stroke it follows that the work planed must be parallel providing the knee is properly supported which is another question.

I will leave it to the readers of MACHINERY if it would not be more desirable to secure a medium degree of stiffness in the ram and to have it uniform than to secure great rigidity at the beginning and a more or less unstable support at the end of the stroke with the resulting "fan tail" product. F. EMERSON.

Newark, N. J.

* * *

WHERE IS HE?

Editor MACHINERY:

Some years ago a gentleman came to my place of business, claiming to have a process of converting wrought or malleable iron into tool steel. He had quite a collection of samples, and among other things was a blade, like a pocketknife blade, forged on the end of an old horseshoe; several cold chisels made from railroad spikes, and three or four malleable-iron hatchets for lathers. I have no reason to doubt that all of the articles were genuine. The pouring gate was very plain on the hatchets and the eye was cored without doubt, as was also the checkered face. The general appearance indicated malleable iron. The cutting edge was blunt, necessitating being dressed at the forge, which I did, and they worked in every way as if they were genuine tool steel and took excellent temper, they having previously been subjected to his process. After dressing these hatchets they were ground and whetted to a very keen edge—so fine that they would shave very nicely; then they were subjected to all manner of abuse, such as chopping hard wood, knots, sandy timber, and, lastly, chipping castings, bar-iron and wire nails without any such effect on the cutting edge as might be expected. The horseshoe blade was stropped to an excellent razor edge and then subjected to such brutal usage as the cutting of wire nails and other metals, and, contrary to expectations, this blade would then shave very nicely.

In my experience of twenty or twenty-five years with steel I have never before or since seen any tools, hand or machine forged, of any grade of steel, or tempered by any process, that would stand the test that was given these samples. Having at that time no immediate use for the process, and being very busy fighting "the wolf," I sent him to an acquaintance who was a manufacturer of edge tools. There he "monkeyed" around for a few days and disappeared as suddenly as he came.

As I am now in a position where I could use this or a similar process to advantage I write this with the hope that some of the readers of MACHINERY can locate the gentleman or give some light on the process. HUGH HILL.

Anderson, Ind.

* * *

SOME NOTES ON CUTTING PIPE THREADS.

Editor MACHINERY:

In cutting threads on pipe the aim is to cut a thread, which, when screwed into a fitting, will make a steam tight joint without the use of red lead, graphite, etc., but owing to numerous causes this result is not always obtained. When the threads, both in the fitting and on the pipe are in good condition, graphite and oil put on the threads will be sufficient to make the joint steam tight, also facilitate the separating of the fitting and pipe when that is necessary. When the fitting and pipe do not screw tight, the result of the thread being cut too deep or some of the thread being broken, the joint may be made steam tight by using red or white lead, but when this is used it will be quite hard to separate the fittings and pipe after the red or white lead has hardened. Sometimes the joint is caulked, but when this is needed the cutting of the threads has been improperly done, and it would be better to cut and properly thread another piece of pipe, although in some cases caulking must be resorted to.

When screwing a piece of pipe into a fitting be sure that it enters far enough to be secure. One or two turns is not sufficient

and many dangerous connections are made by overlooking this little point. Sometimes the thread on the pipe is not cut deep enough and when screwed in one or two turns it "feels" tight and is left as "all right," with the result that sometime afterwards there is a "mysterious steam pipe explosion."

In cutting a thread on a piece of pipe, if after turning the stocks around and applying proper pressure the thread does not start, the trouble may be a burr or some other slight imperfection on the outside of the pipe. This should be filed away all around the pipe then the thread can be started all right.

When cutting threads on short lengths of pipe for nipples, they may be so short that they must be held with a coupling to another piece of pipe which is held in the vise; when such is the case the coupling prevents the bushing from passing its proper distance on the pipe, if the nipple is very short the bushing may be placed on the other side of the coupling, then the bushing is placed in the stocks as far as the coupling will allow it, then bring the dies to cut; after a few threads have been cut the bushing will go into the stock its proper distance and the set-screw can be tightened, then the rest of the threads are cut. When removing the stocks and dies from the pipe, first loosen the set-screw holding the bushing in place. When the nipple is so long as not to admit the bushing being placed on the other side of the coupling use a bushing that will go over the coupling; if it is too large, paper may be wound around the coupling which will lesssen the liability of cutting the threads out of line with the pipe.

CHAS. G. PEKER,

New York City.

* * *

DETAILS OF A STEP BEARING FOR HEAVY DUTY.

Editor MACHINERY:

The article on step-bearings in the July issue has called to mind a bearing of this class which was used in a shop where I was draftsman a few years ago. This shop made stone working machinery, principally, and Fig. 1 shows the iron work of one kind, called a rubbing bed, for polishing the surfaces of stone used in building, etc. This was set in a suitable timber frame-work, with one piece of timber reaching across from one upright to another, just behind the spindle and about one inch above the table. When in use the stone was laid on top of the table and the above mentioned timber kept it stationary while the table turned around underneath. At the same time a mixture of sand

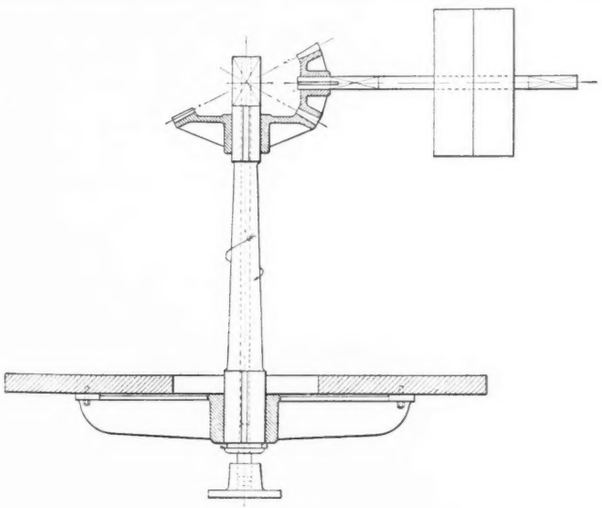


FIG 1.

and water was kept running onto the table which made a sort of grindstone of it. Fig. 2 shows the bottom of the spindle and also the step-bearing. The bottom casting was square with a turned up flange to keep the upper casting from turning and it also had a ball and socket joint in the center. The bushing was made of brass, keyed into the step casting and was a running fit on the pin. The pin and buttons were made of the best grade of tool steel, hardened glass hard and when finished these buttons were about 1-32" full thicker in the center than at the edges, but before being hardened they were made thicker at the edges, as after going through the hardening process they swelled in the middle. Of course the end of the pin was hardened also and showed a bulge in the center of about 1-32". The bottom of the pin, both sides of the two upper buttons and the top surface of the bottom button had grooves as shown in Fig. 3. The bottom button was held in place by two ¼" dowel pins. The pipe at the left is used for filling and when turned down for emptying the bearing of oil, the best lard oil being used. There was a washer

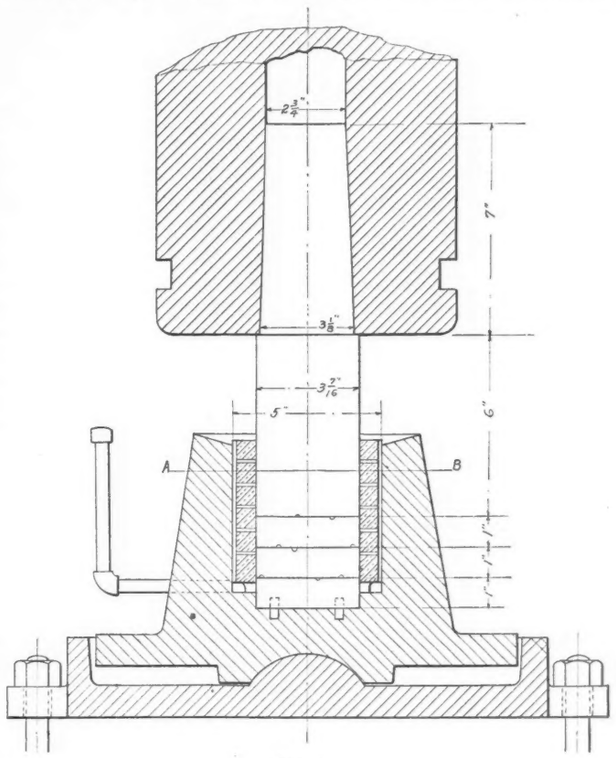


FIG. 2.

of leather over the bearing around the pin to keep out the dirt and grit. The weight on this bearing was 22,000 pounds made up as follows: The table was 12' 6" diameter, 4½" thick with a 48" hole in the center.

Weight of	table	19,050 lbs.
"	" spider	1,484 "
"	" gear	350 "
"	" spindle	1,150 "
Total		22,034 lbs.

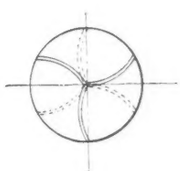


FIG. 3.

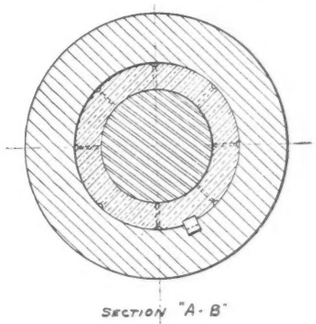


FIG. 4.

This was increased by the weight of the stone, sometimes a ton or more. The pulleys run 72 r.p.m., the gears were 2 : 1, the spindle making 36 r.p.m. This bearing ran for years without any trouble whatever.

F. W. SEIDENSTICKER.

Chicago, Ill.

* * *

SOME CRITICISMS.

Editor MACHINERY:

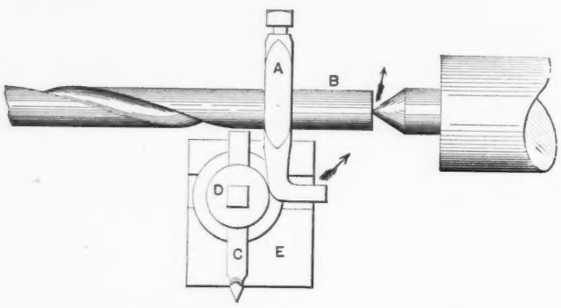
In regard to the method shown by W. C. M. in the August issue of MACHINERY for holding twist drills when drilling in the lathe, I would say that it is not quite right, since the tendency is to throw the end of the drill in the direction indicated by the arrows. In a casting having any blow-holes the result is likely

to be a broken drill, and to my knowledge it has been the cause of breaking three large drills of about 1½" in diameter. Another method, which is nearly the same as that given but much safer, is to place the end of the lathe tool as near the drill as possible thus bringing the point of resistance nearer the line of the centers. I have preached this gospel to machinists and apprentices for ten years, and the three cases of broken drills occurred where I did not insist on my way of holding the drill. In each case the man was a machinist of at least twenty years' experience, and right here I wish to say that it is not a pleasant task to handle men from ten to twenty years older than the "boss."

Some machinists seem to think that by reason of age their methods are best, yet they never read anything pertaining to things mechanical, saying that such reading is good enough for "cubs," but is not necessary for men of their experience.

While I am writing about others an incident comes to mind which shows that many machinists hold the editor responsible for any views aired by various correspondents that are wrong according to their way of thinking. Again, I have loaned my mechanical papers to men who would say "Who didn't know that before?" or "I have forgotten that years ago." It seems that some of these parties have forgotten a great deal or never knew much, as their work and methods speak volumes of things "forgotten."

I become very "tired" when a machinist who has forgotten so much clamps work to a planer or lathe with the bolts from 4" to 6" from the work and the blocking close to the bolt, when it is possible for him to have it just the other way, yet the same man when using a bar to pry a heavy casting from the floor will get the heel or fulcrum close to the piece to be raised. Why is it that they can so seldom see the similarity between the two cases, especially when it is pointed out to them?



DEFLECTING ACTION OF TOOL-POST ON DRILL.

Another thing that is common amongst machinists of the forgetful class is the use of a hand hammer to drive out a tight bolt or mandrel when perhaps a fifty or seventy-five-pound ram would be none too heavy. It seems difficult to "hammer" into the brains of this class that the light blows upset and rivet the end that is being driven instead of driving it out.

Emsworth, Pa. A. MERTES.

[We are aware that many readers of technical journals hold the editors responsible for the views of correspondents and think that nothing should be inserted in the reading columns that is at all "heretical," but it is by the exchange of these new and what often seems to be palpably erroneous ideas that some fact may be brought out of great value. Judging from the changes in the methods of doing machine work in the last score of years no class of artisans can as little afford to be narrow-minded as the machinist.—EDITOR.]

* * *

SHAPER SLIDES.

Editor MACHINERY:

In the May issue of MACHINERY Mr. Hugh Hill suggests a method which will in his opinion tend to eliminate the "fan tail" planing action of the shaper and produce work in which the opposite sides are nearer parallel. While fully agreeing with him that a "camel back" ram would insure greater rigidity, it is evident that without a rigid side, the greater strength of the ram does not avail. To illustrate the point Fig. 1 shows the form of slide generally used which has the top gibs fastened to the frame by cap screws. If the gibs were kept clamped tight by the cap screws they would be fairly rigid, but in order to allow the ram to run freely, it is usually necessary to slacken back the screws a little thereby giving practically a loose gib. Is it any wonder then that the cutting tool plays "hide and seek" with the work being planed?

At a recent exhibition, a really well designed shaper in all parts with the exception of the ram slide, claimed considerable attention. The attendant who had a piece of work in the vice was illustrating the quick change of stroke, speed, etc., and while

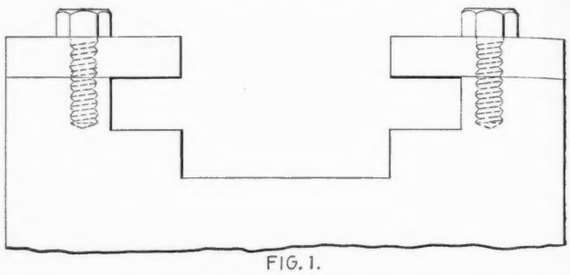


FIG. 1.

doing so he made the statement that the shaper would accurately plane a piece of work full length. I asked him if it would do so without adjusting the gibs and his reply was that "it is not necessary to adjust anything." With his permission I tried the cap screws on the top gibs and was able to tighten each one nearly half a turn with my fingers. The shaper ram must have been dizzy from playing see-saw.

In my humble opinion a slide like that shown in Fig. 2 would insure more stability to the ram. The V groove is cut in the frame and fitted with one gib which, as will be noticed, is adjusted by a double row of screws, giving a full bearing to the gib.

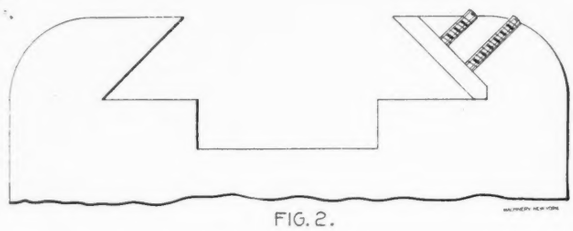


FIG. 2.

Mr. Hill also states that he finds shapers very small in proportion to other machine tools also that a 30" shaper should take as large a cut as a 30" lathe. I am obliged to differ with him in this statement as the power required to overcome the friction in a 30" shaper running full stroke would run a 30" lathe with a fairly heavy cut. T. B. C.

Brooklyn, N. Y.

* * *

ABOUT THE POWER PRODUCER.

Editor MACHINERY:

In the August issue of MACHINERY, under the heading "Another Power Producer," you have edited a very satisfactory article, which is most refreshing in its candor and logic, particularly after reading the purely descriptive and what we might call "say so" productions in some of the contemporary journals. It shows a discrimination against exploiting mechanical devices which are heralded by such a ridiculous series of statements as can be gleaned by an interview with the promoters of this world beater. Whatever real merit which may be present, would readily be killed off by the new engineering catechism which garnishes the pamphlet and verbal interviews. The writer was solemnly assured that a H.P. was 33,000 lbs. lifted one foot; the time evidently having no bearing in the matter. This interesting fact was brought out in answer to the inquiry "What speed does the engine run at to develop the rated power." The answer was that the speed might be anywhere from 10 to 800 r.p.m., and that it had nothing to do with the power of the engine which was 1 H.P. under all conditions. The reference in the pamphlet to the prospective use on boats was on the basis, I suppose, of taking the water from as low a point as possible and using the head resulting from the displacement of the vessel. After reading what goes before, it is a paradox why the author hesitated to dispose of the waste water by the simple method of extending the exhaust through the bottom of the boat. It might add another patent to his long list. W. H. CORBETT.

GRINDING.

Editor MACHINERY:

In your issue of August, in Mr. W. H. Van Dervoort's article on "Machine Tools—Their Construction and Manipulation," in his fifth class, namely grinding, he says: "Grinding operations, although necessarily slow, make possible the accurate finish of the hardest metals."

While I take no exception to the latter part—that the hardest metal can be accurately finished—I do take exception to the statement that grinding operations are "necessarily slow." The grinding machine is only intended for finishing operations and it is much more rapid for this work than the old method of finshing, when it is well understood and a proper machine used, whether it be upon soft or hard metals, and the statement made is misleading.

In using the grinding machine for reducing work a considerable amount the statement is correct, but it should be remembered that the grinding machine was not built for this purpose.

Mr. Van Dervoort may not have intended to convey the idea that grinding is not an economical method. He may, however, have drawn his conclusions either from seeing grinding done on machines not well adapted, or the operator lacked the qualifications or knowledge necessary for the best results. But the fact is, grinding is an economical method of finishing all materials, whether hard or soft, owing to the superior work and the rapidity with which it can be accomplished. A solid machine, well built; proper emery wheels and in good condition, proper speeds of work, emery wheel and feeds; a plentiful supply of water in all cases to keep the work normal—by keeping it cool—and good judgment, which experience soon gives to the apt person, figure much in doing work rapidly, accurately and economically by grinding, which is the proper method and will ere long be universally employed for doing all kinds of commercial work, as well as the finer class, and it is rapidly becoming the general practice.

A. B. LANDIS.

* * *

WRINKLE IN COOLING MACHINES.

A novel application of thermodynamics to domestic purposes has recently turned up in the shape of an air-cooling apparatus for offices, apartments and habitations. It is a somewhat radical departure from previous methods in that the source of the cooling is not, as generally heretofore, the conversion of mechanical work into the abstraction of heat, either directly or indirectly, but merely depends upon the enormous latent heat of vaporization of water. Water from any convenient source is supplied in a thin film to the copper top of a flat convoluted air flue and a sharp air blast is directed axially along and over this flue from a special little blower motor. The forced evaporation chills the air-flue vigorously and drops the temperature of the whole air-blast from 10° to 20° F., according to the rate of evaporation attained. The net result of this arrangement, the details of which are here only sketched roughly, is to send out into the apartment to be cooled about 10,000 cubic feet of air per hour cooled to a temperature of about 68°, on an expenditure of about 100 watts. By adjusting the machine the air supplied can be sent out without any added moisture or with such a degree of humidity as may be desired, and the temperature may likewise be varied, although as usually adjusted the temperature of the air delivered is controlled automatically within a few degrees range. Obviously such an apparatus is not intended or adapted for cold storage work or the like, but within the range required for effective house cooling it is much more efficient than any machine which depends on the degradation of mechanical energy. The new machine is manufactured under patents to Dr. Louis Bell and is about to be placed on the market.—"Electrical World."

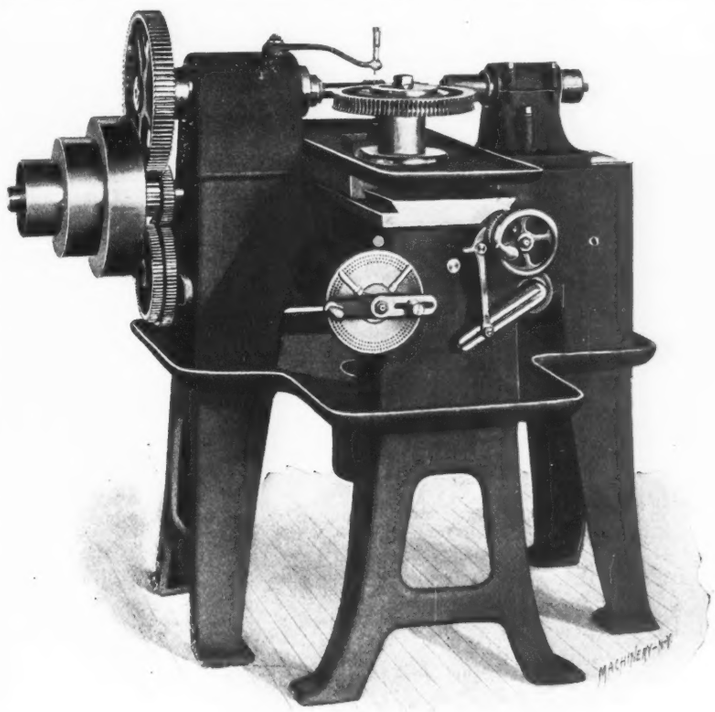
* * *

The August number of MACHINERY was the last number of Volume V. and those who wish the index for this volume will receive it upon application.

AN AUTOMATIC WORM-WHEEL HOBBING MACHINE.

The machine illustrated in connection with this description is one recently brought out by the Grant Machine Tool Works, of Cleveland, Ohio, and is designed for automatically cutting worm-wheels from 2 to 20 inches in diameter of any pitch up to 2 inches. No previous nicking is required, as the machine will cut the wheels from the solid metal at a greatly reduced cost over the ordinary methods usually pursued.

The worm-wheel to be hobbed is mounted on a vertical spindle and is adjusted to the required height by the hand-wheel shown under the frame. For obtaining the correct height a micrometric device is swung over the rim of the wheel, and when adjusted to the width of the rim it forms a gauge for setting the wheel to the same height as that of the arbor carrying the hob. The sleeve carrying the work spindle has a positive



NEW WORM WHEEL HOBBING MACHINE.

movement through a worm and worm-wheel driven by change gears, which can be arranged for either right or left hand worms. The worm-wheel on the work spindle carries a cam on the side of the rim which operates the feed mechanism, having a range from zero to 1-32 inch per each rotation of the hob. The feed motion is limited by a stop, not shown, having a micrometer reading, which, being properly adjusted, stops the feed when the hob has advanced into the worm-wheel to the correct depth.

An index on the shaft can be used instead of the change gears for cutting wheels of any kind which require a number of teeth or notches around the circumference. A pan is provided for catching water, oil or chips, and there is also a pan under the whole machine for the same purpose.

We are informed that a pump can be attached when wanted at an extra charge; also that the total weight of the machine when boxed for shipment is 1,750 pounds.

* * *

The "American Shipbuilder" says that it is getting to be pretty well understood that the frequent breaking of propeller shafts is not due to the defective material of the shafts themselves so much as to the excessive strains to which they are subjected, owing to the working and straining of the hull of the ship in a seaway. Careful measurements taken on a steamer in heavy weather showed that the propeller shaft was at times sprung out of line 1¼ inches in a length of 112 feet. Measurements on deck showed the same amount of deflection. The ship was stiffened, and the shafting gave no further trouble.

PRACTICAL PROBLEMS.

ANSWERS TO PROBLEMS 19 AND 20.

Problem 19.—The most practical method for calculating the diameters of the various steps of two cone pulleys of unequal dimensions for open belts seems to be to find the belt length required for the two given steps and to use it as the determining limit for the remaining steps. This method is perfectly logical as it is required that the steps shall be of such size that no matter what the ratio may be between them, the belt will have an equal tension on any pair.

Some readers of MACHINERY may remember an article on "Cone Pulleys and Belts" by W. L. Cheney in the issue of April, 1895, which gives some simplified formulas for determining the various sizes of the steps and on account of its simplicity we will use the one given for finding the belt length in solving this problem.

The formula is: $\text{Length of belt} = 2\,C + \frac{11\,D + 11\,d}{7} + \frac{(D-d)^2}{4\,C}$

in which C is the center distance, D the diameter of the large step and d the diameter of the small step.

The belt length for the middle steps can then be found as we know the size of the smaller step is 8" and as its ratio to the middle step of cone pulley B is as 4 is to 5, the diameter of that step must be 10". The center distance is given in the problem as 18" so we have

$$L = 36 + \frac{110 + 88}{7} + \frac{(10-8)^2}{72}$$

Clearing the equation results in the belt length being 64.341", and we can use this length in the same formula to determine the remaining steps since the ratio that must exist between each pair of steps is established by the conditions given.

The ratio between the middle steps is to be multiplied by 1.6 to obtain the ratio for the next larger step on cone pulley B or $\frac{4}{5} \times 1.6 = 2$. As we now have the ratio existing between these steps, we can substitute the ratio in the formula and determine not only the relative sizes of the pair of pulleys but also the actual diameter of one and from that the diameter of the other step.

Substituting the known values and expressing the value of D in values of d the formula becomes:

$$64.341 = 36 + \frac{22\,d + 11\,d}{7} + \frac{(2\,d-d)^2}{72}$$

Clearing the equation of fractions results in

$$32427.86 = 18144 + 2376\,d + 7\,d^2$$

Transposing the terms and completing the square gives

$$7\,d^2 + 2376\,d = 14283.86$$
$$d^2 + 339.51\,d = 2040.55$$
$$d^2 + 339.51\,d + 28803 = 30843.55$$

Extracting the square root and transposing terms gives the diameter of d.

$$d + 339\,51 = 345.42$$
$$d = 5.91''$$
$$D = 5.91 \times 2 \text{ or } 11.82''$$

Having obtained the diameter of the two steps the result can be proved by the following method:

Draw the lines A D and G J, perpendicular to the center line C I, Fig. 1, and the line B H, tangent to the circles representing the respective diameters 5.91" and 11.82". The radii C B and I H drawn to the point of tangency will be perpendicular to B H. Draw the line F I parallel to B H, and the result is the right angled triangle I F C, in which the length of C I and F C is known.

$$\overline{CI}^2 - \overline{FC}^2 = \overline{FI}^2$$
$$C\,I = 18 \text{ and } F\,C = \tfrac{1}{2}(11.82 - 5.91 = 2.95$$
$$\text{Hence } 324 - 8.7025 = 315.2975$$
$$\sqrt{315\,2975} = 17.75''$$
$$17.75 \times 2 = 35.58'' \text{ total length of straight belt.}$$

The length of belt encircling the pulleys is found by ascertaining what part of the circle is embraced by the belt in each case.

$$\text{Cosin angle } F\,C\,I = 17.75 \div 18 = .98611$$
$$\text{Angle } F\,C\,I = 80°\ 30'$$
$$\text{Angle } A\,C\,F = 90° - 80°\ 30' = 9°\ 30'$$

$9°\ 30' \times 2 = 19°$, which is to be added to 180° for the large step and subtracted from 180° for the small step.

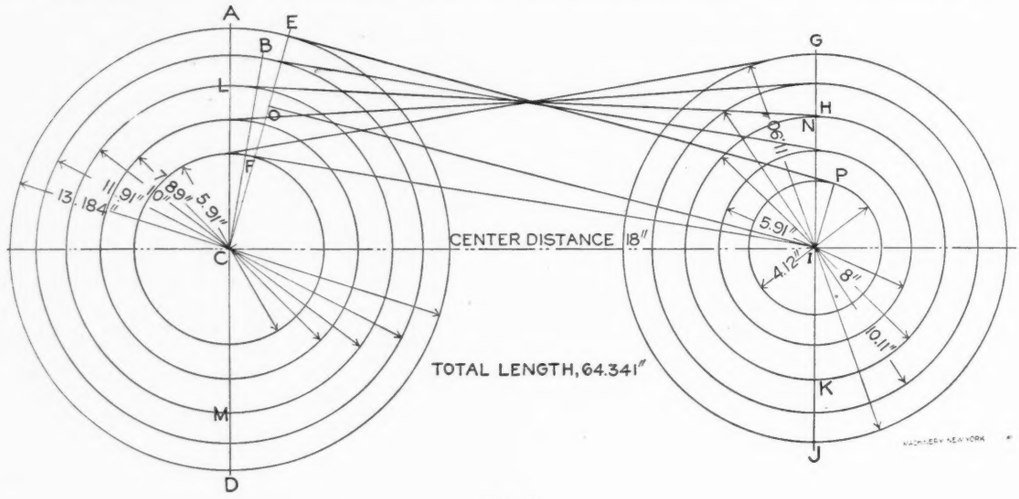


FIG. 1.

$$180° + 19° = 199°$$
$$180° - 19° = 171°$$
$$5\,91'' \times \frac{22}{7} \times \frac{171°}{360°} = 8.03''$$
$$11\,82'' \times \frac{22}{7} \times \frac{199°}{360°} = 20.811''$$

$3.55'' + 8.03'' + 20.811'' = 64.341''$, which indicates that with the steps of the diameters given, the tension of the belt would be the same as on the middle steps.

To find the diameters of the next pair of steps we proceed in the same manner as with the first pair found.

$$64.341 = 36 + \frac{35.2\,d + 11\,d}{7} + \frac{(3.2\,d-d)^2}{72}$$
$$32427.864 = 18144 + 3326.4\,d + 33.88\,d^2$$
$$33.88\,d^2 + 3326.4\,d = 14283.864$$
$$d^2 + 98.18\,d = 421.6$$
$$d^2 + 98.18\,d + 2409.828 = 2831.428$$
$$d = 4.12''$$
$$D = 13.184$$

It will be noted in the equation that using the value of D in terms of d necessitates the multiplication of 11 by $2 \times 1.6 = 35.2\,d$.

The proof of the result obtained is obtained in the same manner as with the preceding case.

Drawing the line O I parallel to E P, we obtain the right angled triangle C O I, in which C I equals 18" and O C equals $\frac{1}{2}(13.184 - 4.12) = 4.53$.

$$18^2 = 324$$
$$4.53^2 = 20\,52$$
$$324 - 20.52 = 203.48$$
$$\sqrt{303\,48} = 17.42''$$

$17.42 \times 2 = 34.84''$ length of straight belt.

$17.42 \div 18 = .96777$ cosin angle E C I

Angle E C I = 75° 30′

Angle E C A = 14° 30′

14° 30′ × 2 = 29°

180° + 29° = 209°

180° − 29° = 151°

$$4\ 12 \times \frac{22}{7} \times \frac{151}{360} = 5.43''$$

$$13.184 \times \frac{22}{7} \times \frac{209}{360} = 24.06$$

$34.84'' + 5.43'' + 24.06 = 64.33''$ or nearly $64.341''$.

Starting from the middle cone we can find the diameter of the other steps in the same manner and can prove the results as has been shown. The proof should always be made as it is a reliable check upon the accuracy of a calculation which is very likely to contain some errors.

The diameters of the steps are shown on the diagram, Fig. 1, and also in the following:

D	d
13.184	4.12
11.82	5.91
10.00	8.00
7.89	10.11
5.81	11.90

$$\overline{WE}^2 + \overline{WB}^2 = \overline{BE}^2$$

W B = ½ (12.095 + 5.905) = 9′,

Hence $\overline{WE}^2 = \overline{BE}^2 - \overline{WB}^2$ or

$\overline{WE}^2 = 324 - 81 = 243$

W E = 15.59

Cosin angle W B E = 15.59 ÷ 18 = .866

Angle W B E = 60°

Angle A B Z = 90° − 60° = 30°

Belt arc A X C = 180° + (2 × 30°) = 240 or ⅔ of the circle.

Belt arc D Y F, is the same proportional part of the circle as is readily seen by inspecting the diagram.

To find the belt length we will take the middle steps and find the lengths of the two arcs and the straight sections.

$15.59'' \times 2 = 31.18$

$10 \times 3.1416 \times \frac{2}{3} = 20.944$

$8 \times 3.1416 \times \frac{2}{3} = 16.755$

Total, $68.879''$

Suppose that the diameter of one step is 18″ and the other to be zero. Then the belt length would be the same since

$18 \times 3.1416 \times \frac{2}{3} = 37.699''$

$15.59 \times 2 = 31.18''$

$68.879''$

This shows that any intermediate steps, the sum of whose diameter is 18″ would require the same length of belt.

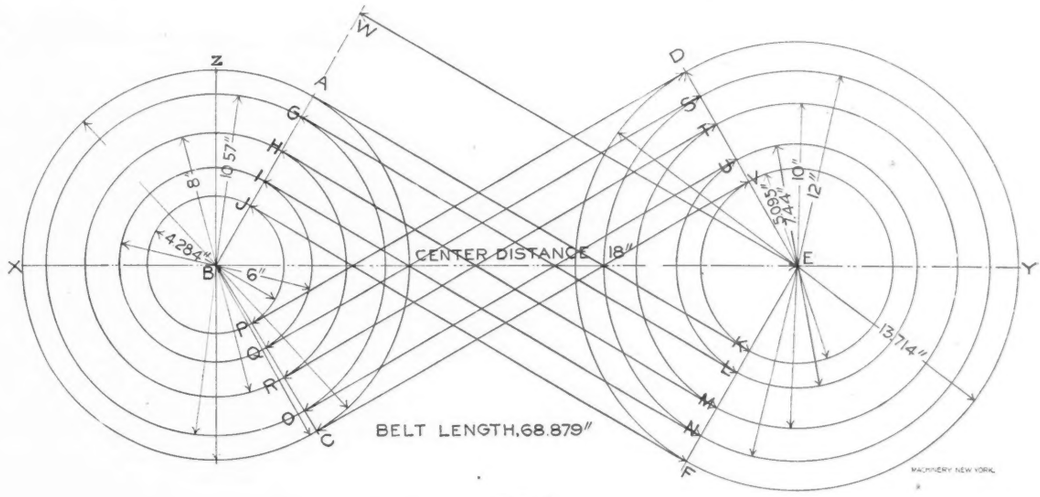


FIG. 2.

Problem 20.—The calculation for the diameters of the steps of cone pulleys intended for crossed belts is a simple matter as will be seen from a careful inspection of the diagram, Fig. 2. If the respective diameters are increased or decreased by the same amounts, the various belt lines A K, G L, H M, etc., will be parallel and the same angular portion of the pulleys will be encircled by the belt in each case. It follows from this fact that if we always keep the sum of the diameters of any two steps a constant amount, the belt will have a constant tension on any pair of steps.

An inspection of the following table of diameters will show that the sum of each pair is equal to 18″ and that the multiplier used is 1.6.

D	d
5 905″	12.095″
7 44″	10.57″
10.00″	8.00″
12.00″	6 00″
13 714″	4.284″

The sizes are obtained by multiplying and dividing the diameters of the middle steps by the square root of 1.6 which equals 1.265. Thus $10 \times 1.265 = 12.65$, and 8 divided by $1.265 = 6.324$. $12.65 + 6.324 = 18.974$, but as the sum of the two steps must be 18, it is necessary to multiply each result by $\frac{18}{18.974}$ which gives 12″ and 6″.

The belt length required is found by extending B A to W, and drawing W E parallel to A K. Angle B W E is a right angle therefore triangle B A E is a right angled triangle.

Mr. E. T. Albenger of Philadelphia, Pa., sent an extended demonstration of this problem which we are unable to reproduce.

The department of "Practical Problems" will be discontinued on account of the time required for its proper management, but if at any time any reader wishes to propose some question of practical value, we will give it space.

* * *

The work done by steam in an engine may be likened to the effect of water on a turbine wheel. The useful work performed by the steam is accounted for by the fall in temperature, while in the case of the water it is that due to the fall of the water from the head- to the tail-race. In the case of the steam engine we are constantly reminded of the enormous loss incident to allowing the steam to escape at what is comparatively a high temperature when referred to the absolute zero, but in the case of the water-wheel no one ever thinks of complaining of the great loss of efficiency due to our inability to have the level of the tail-race located at the center of the earth. While this comparison may seem absurd there are in each case the same analogous conditions existing that render the seeming loss in the engine no more to be regretted than in the case of the turbine wheel.

* * *

It is reported that the E. P. Allis Co., of Milwaukee, Wis., the well-known engine builders, have leased the Lake Erie Engineering Works at Buffalo, N. Y., and expect to have 500 men at work there by September 1.

VARIABLE SPEED MOTOR.

In the accompanying illustration, Fig. 1, is shown a combined portable motor and flexible shaft as now made by the Stow Manufacturing Co., Binghamton, N. Y. These outfits are made in sizes capable of drilling up to half inch for the smallest size to those that will drill a hole two inches in diameter, or do other work requiring equal capacity.

The motor shown is of a new variable speed type which will give 60 per cent. variation, and it is claimed, without loss of efficiency. The method of accomplishing this result is clearly shown in Fig. 2. The upper pole piece is hollow and the cavity

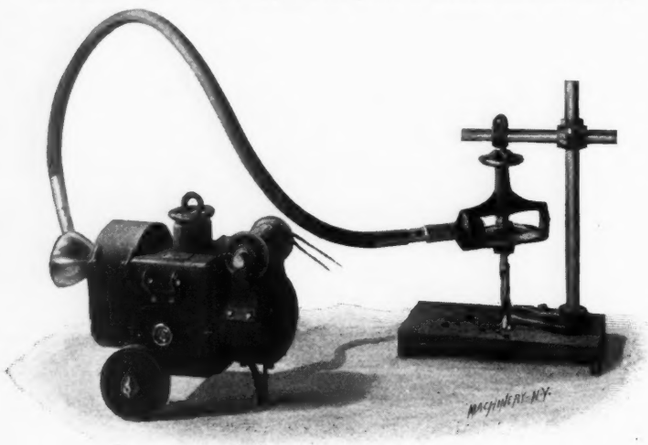


FIG. 1. MOTOR AND FLEXIBLE SHAFT.

is filled with a soft iron cylinder, the position of which can be adjusted in or out by means of the eye-bolt and hand-wheel. When the cylinder is wholly or partially removed from the cavity, the total magnetic flux will be greatly decreased, thus raising the speed while the magnetization of the pole tips will remain sufficiently strong for sparkless commutation.

Tests have been made upon a one horse-power inclosed shunt motor of this type. This machine was wound for 110 volts, and the field current was 0.36 ampere. It was found that an elevation of the plunger of about 2½ inches increased the speed from 830 to 1170 revolutions per minute, and that the motor would run sparklessly in either direction, under all loads up to

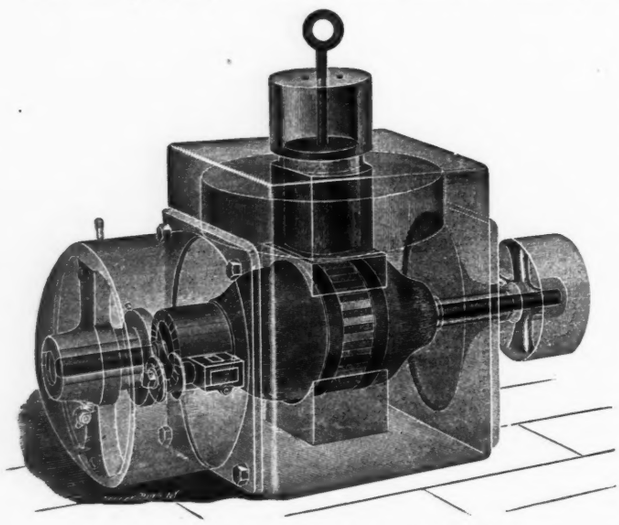


FIG. 2. SHOWING SPEED REGULATING DEVICE.

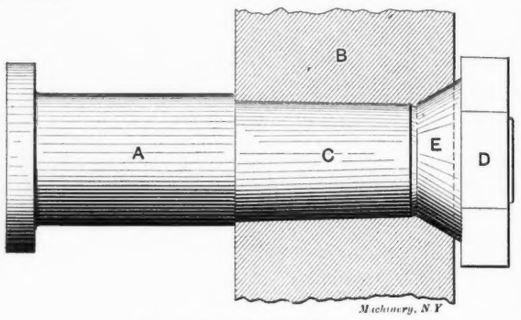
50 per cent. overload and at all speeds between the above limits, without changing the position of the brushes. Furthermore, while the motor was running under full load, the plunger could be suddenly lifted to its full height, thus instantly raising the speed by almost one-half, and athough the ammeter needle would momentarily register about 23 amperes, no sparks were perceptible at the brushes.

This method of speed regulation abolishes the rheostat altogether, as it is not even used as a starter. When the motor is to be used for direct connection to machine tools instead of with the flexible shaft, it will be found that the form in which it is made, with three flat sides, makes it specially adapted to the purpose. The motor is also about one-third lighter than the iron-clad type which this company has heretofore used extensively.

* * *

A REMOVABLE CRANK-PIN.

Apropos of the method shown by Mr. Halloway in the "Shop Kinks" on another page, for trueing worn crank-pins of the ordinary riveted form, it may be of interest to note a form of crank-pin designed by Mr. Arthur of the Arthur Company, New York, for obviating the troubles incident to keeping the ordinary form of pin true. This style of pin is in use on a small Corliss engine used for driving the shop dynamo but Mr. Arthur states that he would have no hesitation in applying it to a large side crank engine and an examination of the scheme seems to call for its endorsement, as it certainly has the merit of solidity with the manifest advantage of being easily removed and turned in the lathe when worn.



PIN AND SECTION OF CRANK,

The idea as illustrated by the sketch is the combination of a taper fit C in the crank disc B, with a nut D having a tapered part E which fits in a recess of the same shape in the crank disc. A well fited taper pin is a solid and reliable form of construction as is evidenced by its extensive use in locomotive work and by making the nut of the form shown, it becomes solidly locked so that there is no liability of loosening by the vibration.

* * *

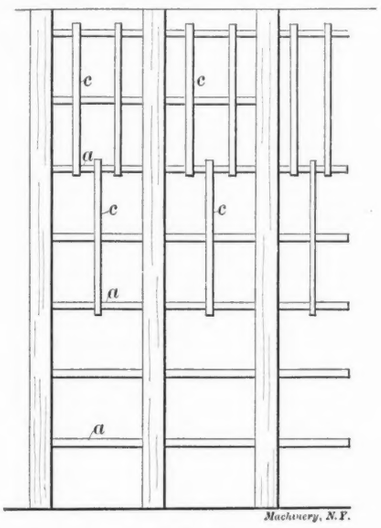
NEW SHOPS OF BEAMAN & SMITH.

Beaman & Smith, Providence, R. I., have recently built and moved into new works, and now have a modern plant well adapted to the growing needs of the business As is well known, this firm manufactures milling and boring machines also other machine tools, many of which are of a special character. The demand for such machinery is not only increasing daily, but the tendency is toward heavier and more powerful machines to perform work that either was not done at all a few years ago or else was done on an entirely different type of machine. The new works not only afford increased capacity but provide the means for turning out machines of large size. Two boring machines of 45 tons capacity have lately been shipped and two others of similar design are now in the works.

The main building of the plant is 128 x 60 feet, with a wing 20 x 48 feet. The building is of self-sustaining steel construction with brick walls between the steel columns and there is room to add to both the end and the side of the building making it 120 by 250 feet in size. The large tools and erecting floor are served by a ten-ton Shaw electric crane and the tools throughout are driven by electric motors. These motors are distributed about the plant, a twenty H.P. motor driving the small tools, a fifteen H.P. motor the planers, a ten H.P. motor the milling and drilling machines, and even the tool room has its own drive in a three H.P. motor. One large Gray planer has its own motor. The shop is heated by the Sturtevant system of hot air, with the fan driven electrically. A convenient appliance is a three H.P. portable motor that is used to drive the machines built in the shop after they have been erected. At the time the writer called, this motor was attached to a heavy milling machine which was surfacing its own table in place.

As might be expected, a firm engaged in work of the character done by Beaman & Smith collects a great many patterns and it is important to have ample and secure storage room for

them. Their building for pattern storage is 64 by 30 feet, three stories high and has several novel features. The windows are all made with one sash only and do not open, to obviate the danger from sparks coming through an open window or from rain beating upon the patterns. To secure ventilation there is an opening through the lower floor, with a screen to protect the opening which allows a current of air to pass into the building from the outside. A ventilator in the roof allows the heated air to escape. All the windows have corrugated glass which diffuses the light and keeps the direct rays of the sun from inside the building.



STOCK RACK.

A building has been erected for bicycle storage, and the lavatories and coat room are well fitted up. In the stock room the rack for the bar iron and steel is a little out of the ordinary and a section of it is shown in the accompanying sketch. The main uprights are of wood through which horizontal holes are bored for the pieces of round bar iron as shown at a, a, a. The lower part of the rack has large spaces for the larger sizes of stock, and in the upper part of the rack these spaces are divided off by vertical pieces of flat iron, through which holes are drilled for the horizontal bars. The construction will be made clear by the sketch.

* * *

SOCIETY NOTE.

"Cornelius Vanderbilt, Jr., though a millionaire, has invented a locomotive." So says a New York daily under a startling scare heading. Reading down the column we glean the following important facts:

(Special Dispatch.)

"Newport, Aug. 16.—Cornelius Vanderbilt, Jr., has proved to be a genius, and although at odds with his father, he is the smartest member of the Vanderbilt family. He always has been of a mechanical turn of mind, and has designed a sailboat and electric launch.

"It will be news to the world to know that this young millionaire is the inventor of a locomotive, every part of which was made from designs furnished by him. The engine has been built and tests are now to begin. A special feature of the Vanderbilt locomotive is the firebox, and if it turns out as Mr. Vanderbilt expects, will be a big saving of labor and money. This particular firebox is arranged so that it can be removed, when burnt out, or for cleaning, and replaced in one night, the removal of a few bolts being all that is necessary.

"The tests will be watched with great interest, not only by the mechanical world, but by society."

* * *

DIAGRAM OF PULLEY WEIGHTS.

WM. SANGSTER,

Several years ago a friend gave the writer a list of pulleys and their weights, compiled from the records of a jobbing shop, which had installed a large number of plants for power transmission. The list gave the weights of pulleys from 6″ to 42″ diameter, and from 3″ to 16″ face, and represented an average of several years' practice, as the weights had been plotted and curves drawn through them. The writer has again plotted the weights and deduced an appropriate formula.

The curves in the accompanying diagram are seen to be a series of diverging straight lines. These lines are the result of two factors—one a constant for each diameter and the other a factor of diameter and face. The formula is somewhat complicated, but not necessarily so if one owns a table of logarithms and a slide rule.

It may readily be seen that an equation, probably varying as the square of the diameter, would give the weight of arms as a constant for each diameter of pulley, and this equation is expressed by

$$.0362\ D^2 - 2$$

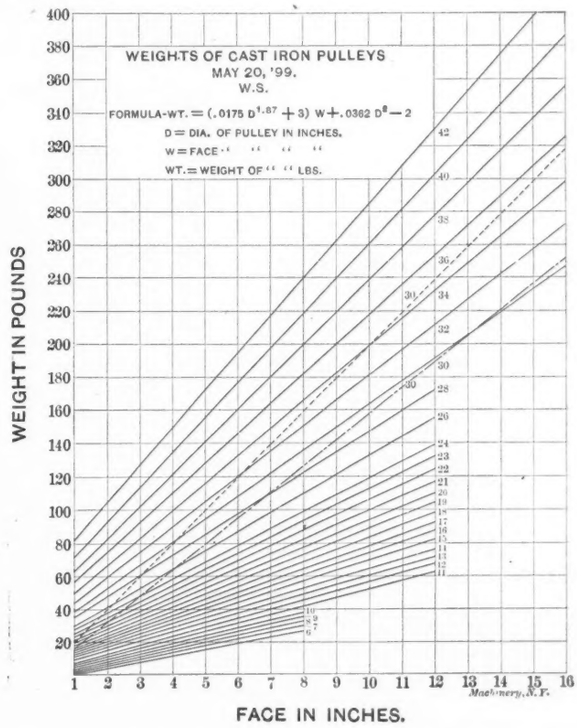
The rims on the larger pulleys are thicker than those on the smaller ones, and the equation,

$$.0175\ D^{1.87} + 3$$

gives the weight of rim for each inch of width. D in each of these equations represents the diameter of pulley in inches. The combined equations

$$.0362\ D^2 - 2 + (.0175\ D^{1.87} + 3)\ W$$

where w = face of pulleys in inches will be found to be fairly accurate for estimating pulleys from 10″ to 42″ diameter. Pulleys under 10″ diameter easily vary 100 to 200 per cent. in weight, owing to the various sizes of shafts with their corresponding diameters of hubs. The formula is not correct in the case of a 6″ × 1″ pulley, which, according to the diagram, has no weight.


WEIGHTS OF CAST IRON PULLEYS
MAY 20, '99.
W.S.
FORMULA-WT. = (.0175 D^1.87 + 3) W + .0362 D^2 − 2
D = DIA. OF PULLEY IN INCHES.
W = FACE " " " "
WT. = WEIGHT OF " " LBS.
WEIGHT IN POUNDS
FACE IN INCHES.
Machinery, N.Y.

The perpendicular lines on the diagram represent the widths of the faces of the pulleys and the diagonals the diameters, both in inches, while the horizontals give the weights in pounds. To find the weight of a pulley look for the diagonal giving its diameter and follow along this line to the perpendicular, representing the face. The horizontal line at the point of intersection gives the required weight.

In Clarke's "Pocket Book," page 445, we have two formulas given for weights of pulleys. One for pulleys from 1 to 4 feet diameter

$$\text{Weight in pounds} = 7\ D - 1.75 \quad (1)$$

and the second for pulleys from 2 to 7 feet diameter

$$\text{Weight in pounds} = 11.625\ D - 9.25 \quad (2)$$

In both cases the formula gives the weight per inch, width of face, and D represents the diameter of pulley in feet. These formulas are represented on the diagram by a dotted line for equation (1) and a dash-and-dot line for equation (2), both for a 30″ pulley.

TO UTILIZE THE COOLING WATER OF GAS ENGINES.

Mr. O. F. Allen calls attention by an article in "The Gas Engine" to a matter of economy that is usually neglected in the operation of these motors:

While every one who has to do with gas or gasoline engines knows that they all require artificial means for cooling the cylinder, how many users of fluid fuel engines know what proportion of the total work done is expended on the water jackets, or, knowing, have sought to utilize that energy.

Several reports of exhaustive tests of engines of moderate size have come to my attention, and they show that from 20 to 50 per cent. of the heat developed by the combustion of the fuel is taken away by the water used for cooling the cylinder. There is also a large amount of heat carried off by the exhaust gases, which will not be considered here.

The temperature of the water in the packet has a great influence on the power developed. I have often gone to the valve on the water inlet of a small engine used for charging storage batteries, where the load is always the full capacity of the engine at the speed it is adjusted to, and by manipulating it slightly have changed the output over 20 per cent., with the same fuel consumption, without touching another part of the engine or dynamo. There is a certain temperature for each engine and for each load condition, at which the engine has a maximum efficiency. If the cooling water is above or below that point, the power development is decreased. I would suggest that a thermometer be placed on the inlet and outlet pipes of all fluid-fuel engines of moderate or large size, and the attendant in charge determine by the difference in temperature between the ingoing and outgoing water which gives the highest efficiency for full load and various fractional loads which often occur.

When these have been determined by trial they may be marked on a card posted near the engine, and whenever there is any marked change in load conditions the temperature of the water can be adjusted to suit. The fuel consumption would certainly be much lower and the regulation more satisfactory. The thermometers can be screwed in by the attendant; such thermometers as are used on feed water of steam boilers or on kitchen boilers in modern houses are well suited to the purpose. Assuming that an engine is fitted up so as to waste as little heat as possible on the water, there still remains something like 30 per cent. on the best engines, and 50 per cent. on the poorer ones, of the total heat developed which is thrown away—sent into the sewer or radiated from expensive cooling tanks set in the coolest place which can be found about the premises—all wasted.

Take a 50 H.P. engine, for example, which is burning the equivalent of a thousand feet of city gas an hour: who would buy five thousand feet of gas a day and burn it out of the top of the chimney, or use it to heat the back yard of a factory? You say it is necessary? I admit it is necessary to draw that amount of heat from the engine cylinder by means of the water jacket, but there are few places where it is necessary to waste all that heat. I will mention a few classes of installations where the heat may be used to advantage all or a portion of the year to reduce other fuel bills. I cannot call attention to nearly all uses, but suggest these as typical.

Frist, small engines in dwelling-houses for pumping water or driving dynamos. In every house which can afford a pumping engine there is a domestic hot-water boiler. It is now customary to connect one boiler to both a gas and a coal range. As the temperature of the water-jacket is equal to or above that which usually prevails in a kitchen boiler, why not connect it also and let it help supply the hot water for the house, thus saving coal in winter and gas in summer. The previously wasted heat is thus made available all the year.

If a gasoline engine is used about large stables where warm water is required for mixing food for animals, let the circulating tank be supplied with a ball-cock to keep it full, and put a faucet near the outlet of the water-jacket, from which to draw the required hot water. In factories and institutions hot water has many uses—in the wash rooms, for instance; and for a dozen and one purposes, in fact, which will occur to each reader according as he is interested. By the arrangement of a tank automatically kept full, warm water may be drawn near where it leaves the engine and made use of. Gas engines are beginning to be used in laundries. Heat is required in the drying-rooms. They can be piped for heating by hot-water circulation, and at least a portion of the work formerly done by steam be performed by the gas engine.

The larger engines may be divided into three classes: Engines in pumping plants, engines in large buildings for operating electric plants, and engines for operating the electric department of combined gas and electric-light companies. Many pumping plants have small buildings devoted to their exclusive use, which are heated by stoves, furnaces, or other devices. At comparatively small expense, hot-water radiators could be connected to the engines as they would be to an ordinary hot-water heater, and the wasted heat thus take the place of a portion of all of the fuel commonly used in winter.

With a supply tank connected as to the ordinary dwelling-house hot-water heater, the arrangement would be safe and efficient. In office or public buildings the water jacket may be connected to a special radiator in the basement, where the engine usually is, this radiator to be arranged to supply hot air to a portion of the building in the same manner as the so-called "indirect" steam or hot-water heating systems. If the building is heated by a hot-water system, the engine jacket may be connected to a heater on the principle of a feed-water heater, and partially heat the water as it comes back from the radiators to the regular heater. With either method the heat thus utilized effects a positive and considerable saving in the fuel bill.

Near the station of a combined gas and electric-light plant there is usually a large gasholder. In northern parts of the country the water in the tank has to be artificially heated in winter. Such a tank makes the best kind of circulating tank for a gas engine. Connected to it by only two pipes—in occasional instances with a small circulating pump in circuit—the great body of water forms a reservoir, which is very slow to change its temperature, and therefore the valves on the water-jacket would require little attention. The heat developd would in many cases be sufficient to keep the holder-tank from freezing. Gas companies seeking to introduce large gas engines do not seem to have considered these uses to which a portion of the energy of the gas may be applied, either at their own or their customers' premises.

While only a few means for saving the heat of cylinder cooling water have been mentioned, there are so many others that probably nine fuel plants out of ten of over 5 H.P. could find profitable uses to which the surplus heat might be applied during all or a portion of the year. There are few places where there is a gas or gasoline engine of any considerable size where there is not a demand for heat between normal and 140° F. The application of a thermostat for regulating the supply of water to engine jackets is worthy of investigation, and I hope soon to try some experiments with a view of determining the advantages, if any, of such a device on the water outlet pipe.

As the number of fluid-fuel engines in use increases, more attention will be paid to this matter, and it does not seem extravagant to predict that in 50 per cent. of the first-class installations of 30 H.P. and over at least 10 to 15 per cent. of the total fuel consumed will be utilized as a heat by product, thus reducing the cost of power considerably.

* * *

In a recent issue of the "Mining and Scientific Press" a writer says, in speaking of the various mines which he has visited, that those concerns conducted on such conservative lines that the "No Admittance" sign is in evidence all over the place, have back of this policy a fear of criticism rather than that some visitor may learn secrets which may prove to his advantage elsewhere.

Can it be possible that there is something akin to this condition of affairs in many of the machine shops that have the signs "Keep Out," "Visitors Not Allowed," and others of equally depressing character prominently displayed?

* * *

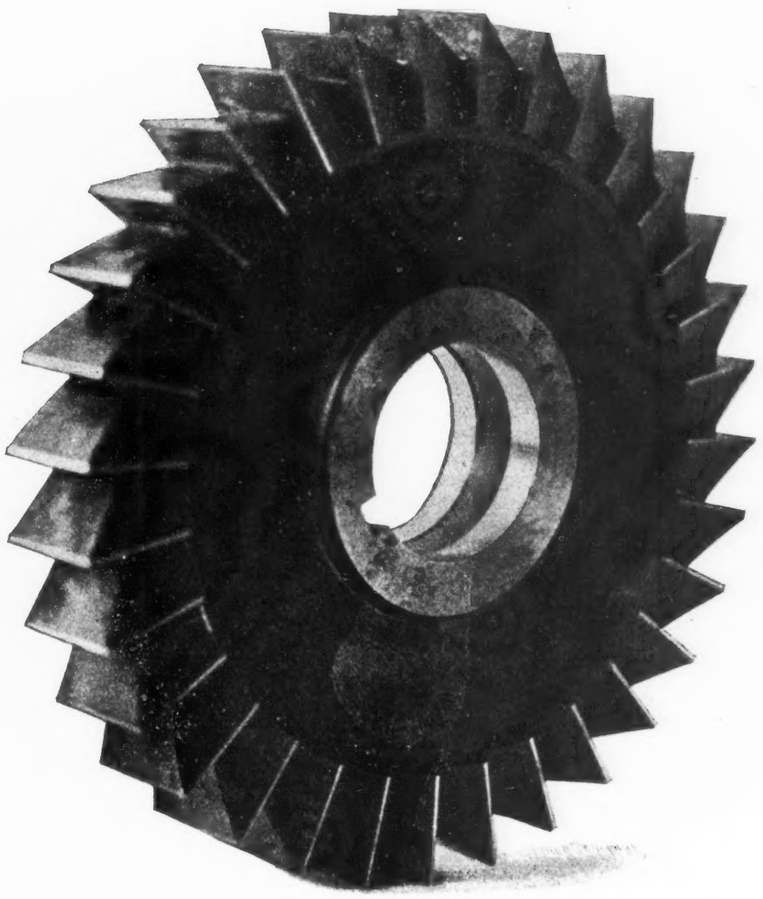
A hot bearing in the dusting machine of a paper mill near Sheffield, England, caused a fire, resulting in damage to the extent of nearly $125,000. It is obvious that the oiling of machinery, especially that running at high speed, cannot be too carefully attended to.

Brown & Sharpe Manufacturing Company,

Providence, Rhode Island, U. S. A.

Milling Cutters, Gear Cutters.

36 Varieties. 3,500 Sizes Usually Carried in Stock.



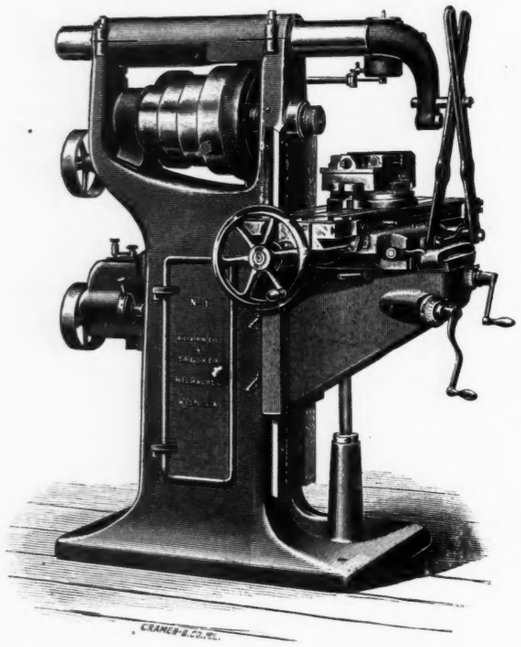
We are prepared to furnish Special Cutters of any desired Shape or Size. Our Catalogue can be obtained through the trade, or we will mail it to any address upon application. It Contains Full Lists of Cutters.

A PLAIN MILLING MACHINE.

The manufacturers of this machine, Kearney & Trecker, of Milwaukee, Wis., state that it was designed for the greatest possible range with the least possible overhang of the parts, and that it is capable of taking the heaviest of cuts efficiently.

The frame is all in one piece, with the metal so distributed that unusual stiffness is obtained for a given weight. The overhanging arm is provided with an adjustable bronze bushing to support the end of the arbor, and the arm-braces afford additional stiffness. The braces are so arranged that they may be removed without taking off any nuts, a feature that often saves time and annoyance.

The table, which is provided with an oil-pan, has a working surface of 10 by 36 inches, and three tee slots, 11-16 inches wide. The knee of this machine is strongly built and is made without a hole through the top to admit dirt or to weaken it when subjected to side strains, and has a vertical movement of 20 inches.



KEARNEY & TRECKER PLAIN MILLING MACHINE

A special feature of the machine is the feed mechanism, which is automatic in either direction for the table, and can be thrown in or reversed by the same handle on the front of the machine. The feed can be tripped either automatically or by hand as easily when working with a full cut as when operating light, and also has the valuable feature of being changed from .006 inch to .13 inch without shifting a belt or changing a gear. Ball bearings take the thrust of the elevating and table screws, thus reducing the friction to a minimum, and all adjustments are indicated on the dials in thousandths of an inch.

Stiffness and simplicity, together with ease of manipulation, characterize the tool, and will undoubtedly result in giving it attention in shops that require a milling machine of this class.

* * *

The usual method of weighing locomotives is to first run the locomotive upon the scales and ascertain the total weight; then take the weight with the driving wheels alone resting upon the scales, and finally obtain the weight with only the forward truck upon the scale platform. While this method may generally answer the requirements of practical work, it manifestly does not give results with that degree of exactness that one likes to attain in engineering work. Accordingly, the Baldwin Locomotive Works have fitted up a series of separate scales, one for each pair of drivers and truck wheels, and the exact load upon each wheel and the total weight of the engine can be determined with precision.

* * *

It has been said that a rolling stone gathers no moss, but the machinist who sticks to the same shop through the best years of his life is likely to gather more moss than experience. The best way to gain experience and self-confidence after having served an apprenticeship is to strike out and see how work is done in other shops.

HOW AND WHY.

A DEPARTMENT INTENDED TO CONTAIN CORRECT ANSWERS TO PRACTICAL QUESTIONS OF GENERAL INTEREST.

Give all details and name and address. The latter are for our own convenience and will not be published.

1.—P. L. H. writes: Will you kindly tell me how to figure the power required to operate a vertical steam hammer. A. We are at a loss to know just what you mean, since the only power used is the heat energy of the steam, and there is no means of determining this. If the hammer falls by gravity alone the available energy is equal to the height of the fall in feet by the weight of the hammer in pounds, and this would be the amount of work required to return the hammer to its original position. If the hammer receives an impulse from the steam, however, the velocity of fall must be estimated, and the formula $\frac{W V^2}{64.4}$ used, where W is the weight in pounds and V the velocity in feet per second. The velocity of a body falling by gravity, simply $= \sqrt{64.4 \times \text{height}}$. This calculation will give the work done by the hammer, and from it must be subtracted the work done by the hammer in falling by gravity to find the work done by the steam on the down stroke. The work done by the steam on the up stroke would be the same as before, or $W \times H$. Having found the work done by the steam in one stroke, the total work in one minute can be found and this divided by 33,000 will give the power. If this answer does not cover the point you wish to know, please write again.

2.—An English correspondent writes: My practice in keying pulleys is different from the ordinary. I cut the keyway between the arms. Where would you cut it, and why? A. We would cut it at the base of one of the arms, because that is the point where there is the most metal, and it would thus weaken the hub the least when cut at that point.

3.—W. M. writes: 1.—Please give me some simple method for computing the gearing on compound geared lathes. 2.—How do lathe and tool builders plane the square part of boxes for lathe bearings? 3.—How is the ratio 8 to 1 obtained in the letter contributed to the last issue upon "Some Examples in Manual Training"? A. 1. See Prof. Van Dervoort's article in this issue. 2.—It is cheaper to mill the boxes than it is to plane them. There are two methods of machining them, both in common use. One is to bore them first, leaving enough to finish and face off where they join together. They can then be held on an arbor in a special fixture for milling, and finally bored and reamed in place in the head stock. The other way is to finish the entire outside first and then bore and ream in place. The method will depend partly upon whether any turning is to be done in finishing the box. 3.—The ratio of a train of wheels is found by first multiplying together the diameters of the drivers; then multiplying together the diameters of the driven wheels, and finally dividing the former product by the latter. Thus in the train mentioned the diameters of the drivers are 6, 8 and 5 inches, and their product $= 6 \times 8 \times 5 = 240$. The product of the driven wheels $= 8 \times 12 \times 20 = 1{,}920$. $240\text{-}1920 = \frac{1}{8}$ when reduced to lowest terms.

4.—W. D. writes: 1.—Please tell me what books would be necessary to enable me to take out an engineer's license. I have run two or three engines, but would like to be able to take out a license, and not knowing enough about engines, fear I could not pass the examination. Can you make a suggestion for a screen for a stack? We tried one screen that was simply fastened over the top of the stack, as in Fig. 1, but the meshes were too fine and filled up. Then we tried one with half-inch meshes, arranged as in Fig. 2. This does not arrest the sparks, however, and one day the roof caught fire. A. You probably will not be able to obtain a license by simply studying books. An important requisite is good judgment, which can come only with experience, and a knowledge of steam machinery, which you say you lack. Books, however, will help you, and we should advise you first to get a copy of Hemenway's Catechism of the Steam Plant, and after you have mastered that, take up Low's Catechism. The first costs 50

cents, and the second $2.00, both of which we can furnish. A year's subscription to "Steam Engineering," which is advertised in this number, would also be of great benefit to you. 2.—For the stack, use a screen with 5-16 meshes and have it arranged as shown in Fig. 3. Having the screen of larger diam-

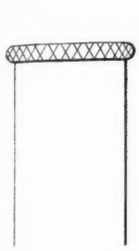


FIG. 1.

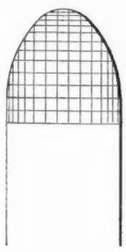


FIG. 2.

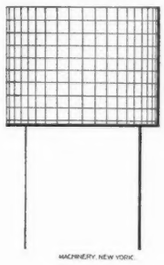


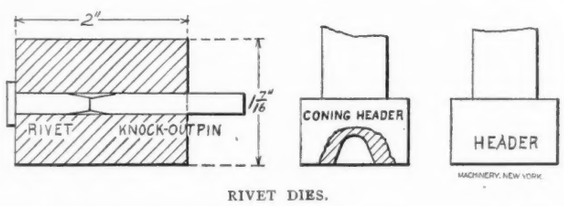
FIG. 3.

eter than the stack allows sufficient opening in case some of the meshes become closed; and the enlargement also has the tendency to check the velocity of the gases, thus forming a sort of settling chamber for the cinders. If you exhaust into the stack you will probably have trouble through corrosion and also through the meshes filling up, whatever the arrangement. In that case the screen should be placed at the bottom of the stack below the exhaust, and, if possible, at a point where the flue is of larger area than that of the stack.

5.—J. S. H. asks: 1.—What is the standard taper for different sizes of gas pipe? Also, what is the size at the top and bottom of the thread at the small end of the pipe? 2.—You published a table some time ago on running and press fits, but did not mention shrink fits. How much should be allowed for that class of work? 3.—Please give me a rule for proportioning the dies that press the heads and points of rivets. 4.—How can I calculate how large to turn a piece of work to have it square up at a given size? A. 1.—The taper for all sizes of pipe is ¾" to the foot, total taper. The sizes wished are as follows:

Diameter Pipe.....	⅛	¼	⅜	½	¾	1	1¼
Top Thread.....	.393	.522	.656	.815	1.025	1.283	1.627
Bottom Thread.....	.334	.433	.567	.701	.911	1.144	1.488
Diameter Pipe	1½	2	2½	3	4	5	6
Top Thread.....	1.866	2.339	2.82	3.441	4.435	5.491	6.546
Bottom Thread.....	1.727	2.2	2.62	3.241	4.235	5.291	6.346

2.—Mechanics generally allow a little more for shrink than for press fits. About 1¼ thousandths per inch will do above 12 inches; between 6 and 12 inches, allow 1½ thousandths per inch; between 3 and 6 inches, 2 thousandths per inch, and for one and two inch shafts the same as for a 3-inch shaft. This is under the supposition that the hub is strong enough to stand the strain. 3.—This question was referred to J. L. Lucas, Providence, R. I., who replies as follows: "The size of a rivet die is governed by the machine in which it is used. It is usually



RIVET DIES.

about 1 7-16 inches diameter and 2 inches long. The head is first coned and then flattened, and removed by the knock-out pin, as shown by the sketch. Draw temper of die to a dark straw." 4.—Multiply the short diameter of the square by 1.414 for the long diameter, which is also the required diameter of the round stock.

* * *

The "Western Electrician" says that experiments in the ether-wave system of transmitting electricity were conducted at Newbury, England, recently. A small powder magazine, located 400 yards from the sending point, was electrically exploded without the use of wires. The experiments demonstrated the feasibility of using the system for destroying mines, etc., in war.

FRESH FROM THE PRESS.

A Practical Course in Mechanical Drawing, by William Fox and Charles W. Thomas, both of the College of New York, contains nearly one hundred 12mo pages, illustrated by many engravings. Published by the D. Van Nostrand Company, New York. Price, $1.25.

The authors have endeavored to present a work that will be adapted to wants of high schools, schools for apprentices and young mechanics, and have abandoned the time-honored method of presenting the geometrical demonstrations first, but have, instead, commenced with working drawings, as it is argued that the average student can grasp the idea of a concrete object much easier than a geometrical proposition. After the student is able to understand the principles of delineation, it is thought that he can more readily grasp the principles and applications of geometry, and will be inspired with a healthful desire to give this subject the study which it merits.

An excellent feature of this book is the reproduction of photographs showing the correct handling of instruments, a point that is the source of much trouble to most beginners.

The most striking feature of "The Century" for September, which will be a Salt-Water Number, is the first installment of Captain Joshua Slocum's "Sailing Alone Around the World." This is the narrative of a daring voyage of circumnavigation, undertaken by the author in 1895, in a forty-foot sloop built by himself in Buzzard's Bay, and taken back and forth across the Atlantic and thence around Cape Horn and the Cape of Good Hope without assistance or companionship. The distance traversed was 46,000 miles, and the accuracy of the navigator's landfalls throughout was a thing to marvel at, his chronometer for most of the time being a little tin clock of the cheapest kind. Captain Slocum was a thoroughly seasoned sailor when he started on his adventurous single-handed cruise, but his unique achievement was not without difficulties and perils that taxed to his utmost his strength, endurance and ingenuity.

We have received an illustrated catalogue of five hundred pages from the F. W. Gesswein Company, 39 John street, New York, entitled "Worth Looking Into." An examination of it seems to confirm the use of the title, as it appears to be worthy of its somewhat novel name, being a very complete list of metal workers' tools and supplies. Aside from its value as a buyers' directory, it contains a number of tables, of much value to the mechanic, especially some that have been calculated for the comparative weights of aluminum, wrought iron, brass and copper wire and plates, Brown & Sharp gauge.

We have received from the Bullock Electric Mfg. Company, Cincinnati, O., their latest bulletin, No. 7934, describing the Bullock engine-type generator. It explains the construction of the generator minutely, gives a detailed sheet of dimensions, and illustrates the generator direct connected to a Nash gas engine.

The Aermotor Company, Chicago, Ill., have issued their eleventh annual catalogue of windmills and pumps, which affords entertaining and instructive reading. The details of the apparatus are shown by artistic half-tone illustrations mingled with the text, and some of the possibilities of the motor are illustrated in a novel manner.

We have received a prospectus for 1899 of the work planned by the International Committee of the Y. M. C. A.. This contains a syllabus of the various courses, with sample examination papers. Two other circulars are also issued, one of which gives the annual report, and the other contains illustrations and descriptions of the exhibits made at the twenty-third international convention, held at Grand Rapids, Mich., last May.

The Pearson Machine Co., 39 West Randolph street, Chicago. Catalogue of machine tools and automatic machinery. This catalogue not only contains descriptions with illustrations of the various machines, but has several detailed sketches that are of interest. Several small sizes of screw machines and turret lathes are shown, as well as a large size for bicycle hubs and similar work. Other machines listed are a lathe designed for facing, a cock grinder, a double turret machine, a horizontal boring and drilling machine of novel construction, and several miscellaneous machines and hangers. The book also contains a table of cutting speeds for turret lathes.

The Joseph Dixon Crucible Co., Jersey City, N. J., have issued an elaborate catalogue, with an artistic cover, containing a full list and description of their various graphite productions. It will not be necessary to list the articles made by this company since they are already familiar to our readers. The catalogue is one that every mechanic should have, and we presume will be sent upon application.

E. G. Smith, Columbia, Pa., manufacturer of measuring instruments for mechanics, has issued a little booklet describing a line of sliding calipers with vernier graduation reading in millimeters, metric micrometers, speriometers and scales. It will be sent to any address.

MANUFACTURERS' NOTES.

The L. S. Starrett Co., Athol, Mass., announce that their cutter department has been sold to F. J. Gay and E. T. Ward, who will continue with this line of goods under the name of Gay & Ward. Mr. Gay was formerly of the L. S. Starrett Co. and had charge of their cutter department.

The Diamond Machine Co., Providence, R. I., write us that Mr. John W. Cole has terminated his connection with that company.

Schuchardt & Schutte, Berlin, Germany, state that their Mr. Crause sailed on August 22 for America, and that any mail for him can be addressed care of Schuchardt & Schutte, 122 Liberty street, New York.

The Frank Mossberg Company, manufacturers of sheet metal novelties, Attleboro, Mass, are now erecting a factory which will have a floor space of over 20,000 square feet. They expect to have it completed by October 1st, and will equip the factory with punching presses, polishing machinery, and light machine tools.

Mr. Julius Herlitschka, manager of the Vienna branch of White, Child & Beney was expected to sail for this country on August 27 to open new business connections, and also attend the Philadelphia Export Congress as a delegate of the Vienna Chamber of Commerce.

De Fries & Co., Berlin, announce that their firm has been reorganized into a stock company, with a paid capital of $360,000.

The Westinghouse Brake Co. announce that after the Russian Government determined to apply air-brakes to the freight trains upon the state railways, an imperial decree was issued announcing that the Westinghouse air brake had been adopted and must be purchased by all roads, private and state. This means the production of air-brake apparatus for 350 locomotives and tenders and 11,750 freight cars during each month for the next three and a half years, the total purchase amounting to from $12,000,000 to $15,000,000.

Who can calculate the amount of money earning time wasted every day in the shops of the land through stopping to take up belts because they are slipping. If a belt did not slip it would be unnecessary to take it up—until the sides touched—and there would be besides relief of strain on belt and bearings, more belt surface producing friction on pulley face, and hence more power. The Cling-Surface Mfg. Co., of 153-159 Virginia street, Buffalo, N. Y., report they have thousands of belts fulfilling these conditions through the use of Cling-Surface. The Journal Printing Company, of Muscatine, Ia., writes: "We have been using your Cling-Surface on our belts for the past two months and unhesitatingly pronounce it an ideal article. We are able to run our machinery now with ease and accuracy that formerly was very imperfect because of belts slipping. We now transmit our power a long distance by belts that are slack, and can start up heavy machinery with ease where before it had to be lifted over by hand. Cling-Surface is all and more than is claimed for it, and we can most heartily recommend its use to all who drive machinery by belting. Our belts were never in better shape. Cling-Surface did it."

FOR SALE.—One of the best located jobbing foundry and machine shops in the Mississippi valley. Good trade established. Satisfactory reasons for selling. Address Box 554, Galesburg, Ill.

FOR DELIVERY SEPTEMBER FIRST, a large variety of second hand lathes, planers, drills, etc., in good order. For list and particulars address JOHN A. CROSS, P. O. Box 218, Providence, R. I.

FOR SALE CHEAP, ONE SEVEN INCH AMERICAN STOKER, made by American Stoker Co. of New York. In good order Apply to W. AMES & Co., Jersey City, N. J.

WANTED.—Copies of MACHINERY for January, 1899, in good condition, for which we will pay ten cents each. Mail these to MACHINERY, 9-15 Murray street, with the name of the sender on the wrapper.

PATENT RIGHT FOR SALE.—The British patent right on a valuable machine tool favorably known and thoroughly introduced throughout the United States. For full particulars please address "MACHINE TOOL," care of MACHINERY, 9-15 Murray Street, New York.

WANTED.—By a large manufacturing company, an experienced mechanical engineer familiar with construction and erection of factory buildings. State age and experience. Address E. W. C., care of MACHINERY, 9-15 Murray St., New York.

WANTED.—Competent machinist as assistant superintendent in a factory near Philadelphia, to oversee toolmakers and make estimates on light contract work. State age, experience and wages required. Address REFERENCE, care of MACHINERY, 9-15 Murray St., New York.

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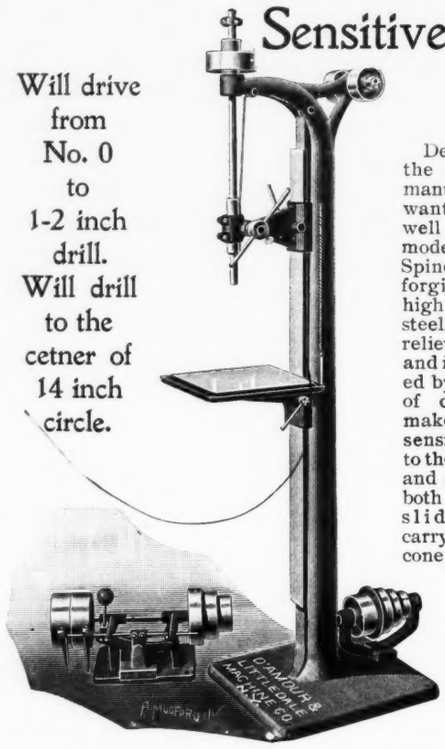
Fresh From the Press..... 26c

14 inch Manufacturers' Sensitive Drill No. 1.

Will drive from No. 0 to 1-2 inch drill. Will drill to the cetner of 14 inch circle.



Designed to meet the requirements of manufacturers who want a thoroughly well made tool at a moderate price. The Spindle is a special forging made from high grade spindle steel. It is entirely relieved of belt strain and is counter-balanced by a weight inside of column which makes it extremely sensitive and uniform to the touch. The table and spindle head are both adjustable on slide. The bracket carrying the driving cone pulley is securely bolted to base of machine, thus preventing vibration of column when machine is running. A thoroughly well made and reliable overhead counter-shaft furnished with machine, and included in the price.

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